38790

US EPA Contract No. 68-W9-0024

ARCS II

FINAL ENDANGERMENT ASSESSMENT
PULVERIZING SERVICES SITE
MOORESTOWN, NEW JERSEY

Volume I of III

REMEDIAL PLANNING ACTIVITIES AT SELECTED UNCONTROLLED HAZARDOUS SUBSTANCE DISPOSAL SITES WITHIN EPA REGION II
(NY, NJ, PR, VI)

CDM Federal Programs Corporation

700001

FINAL ENDANGERMENT ASSESSMENT
PULVERIZING SERVICES SITE
MOORESTOWN, NEW JERSEY

Volume I of III

Prepared for
U.S. ENVIRONMENTAL PROTECTION AGENCY
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February 2, 1996

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PROJECT: ARCS II Contract No. 68-W9-0024
Work Assignment No. 064-2P2J

DOCUMENT CONTROL NO.: 7720-064-EP-CHVL

SUBJECT: Final Endangerment Assessment
Pulverizing Services Site
Moorestown, New Jersey
Document Control No.: 7720-064-RA-CHVK

Dear Ms. Devine:

Enclosed please find a copy of the final Endangerment Assessment (EA) for the Pulverizing Services site in partial fulfillment of the requirements of the project. Please contact me with any questions or comments.

Very truly yours,

CDM FEDERAL PROGRAMS CORPORATION

Robert D. Goltz, P.E.
ARCS II Program Manager

cc: J. Osolin, EPA WAM
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PROJECT:	ARCS II Contract No.: 68-W9-0024 Work Assignment 064-2P2J
DOCUMENT CONTROL NO.:	7720-064-RA-CHVK
SUBJECT:	Final Endangerment Assessment Pulverizing Services Site Moorestown, New Jersey

Dear Mr. Osolin:

CDM FEDERAL PROGRAMS CORPORATION (CDM Federal) is pleased to submit this final Endangerment Assessment (EA) as partial fulfillment of the reporting requirements for the Pulverizing Services site in Moorestown, New Jersey. This deliverable contains both the human health risk assessment and a qualitative ecological assessment.

This submittal is comprised of three volumes. Volume I contains the baseline human health risk assessment, the qualitative ecological assessment and the references. Volume II contains Appendices A through D associated with the human health risk assessment. Volume III contains Appendix E (also from the human health assessment) as well as Appendices F and G associated with the ecological assessment.

This final EA reflects a modification of the draft EA submitted on August 31, 1995 in response to EPA comments received on September 26, 1995 and October 19, 1995. Final resolution to the last of the comments was made with the EPA in January 1996. Final approval of the qualitative ecological assessment was received in December 1995. The following is a summary of the comments on the human health risk assessment (paraphrased for brevity) and the responses taken.

Draft EA Page No.	Specific Comment	Action	Final EA Page No.
Throughout	Remove phrase "per USEPA direction"	Accepted	-

700004

Draft EA Page No.	Specific Comment	Action	Final EA Page No.
4	Correct sentence to read "arithmetic mean"	Accepted	4
30	Correct text to read "...samples were collected from the test pits, which were located in known disposal areas. The test pit data have not been included in the risk assessment because the levels of contamination already indicate that remedial action will be required..."	Accepted	30
56	Cite correct figure illustrating sediment sample locations.	Accepted (Text changed and new figure added)	56 (text) 57 (figure)
69	Correct sentence to read "of the inorganic..."	Accepted	70
74	Reword sentence that describes three, then two chemicals of potential concern.	Accepted	74, 75
75	Correct the typographical error that makes 2 sentences appear as one.	Accepted	76
79, 81, 83, 85, 99, 113	In tables 2-12 through 2-15, 2-22 and 2-24, list OCDD as the detected dioxin. Add a footnote to indicate that an equivalency factor was used to evaluate risk.	Accepted	80, 82, 83, 86, 100, 114
104	Add relative potency valves to Table 2-23.	Accepted	105
110	Add units to Henry's law constants.	Accepted	111, 112

Draft EA Page No.	Specific Comment	Action	Final EA Page No.
113	Clarify in Table 2-24 that fluoranthene is not a chemical of potential concern for Area B surface soil.	Accepted	114
119, 123, 126, 129, 130	In section 3.2, clarify which chemicals of concern in the dermal contact pathway could not be quantitatively evaluated and why.	Accepted	127
129	Either provide clear explanation for the differential treatment of Areas A and C for residential and commercial exposures or evaluate consistently.	Accepted	130, 131
131	Reword sentence to read, "Since the residential ground water exposure... is much more conservative than that of the construction worker, the construction worker exposure... was not evaluated...."	Accepted	131-132
131	Replace statements in the ground water section with verbiage provided on why the deep potable aquifer could not be quantitatively evaluated.	Accepted	132
170	Discuss in the risk characterization section 1) the qualitative comparison of subsurface soil data for Areas A and B with screening data of Area C; and, 2) the test pit soil data qualitatively.	Accepted	186-190
181	Correct sentence to read "future site worker/employee".	Accepted	182
214	Correct sentence to read "Ninetieth percentile or greater".	Accepted	219

Draft EA Page No.	Specific Comment	Action	Final EA Page No.
239	Include a qualitative discuss of the disposal trench area data in this summary section.	Accepted	244

Please feel free to call me with questions or comments regarding this submittal at (212) 785-9123.

Very truly yours,

CDM FEDERAL PROGRAMS CORPORATION

for

Sally Odland
Work Assignment Manager

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LIST OF ABBREVIATIONS

ABS	-	Absorption Factor
AF	-	Soil-to-Skin Adherence Factor
ARARs	-	Applicable or Relevant and Appropriate Requirements
ARCS	-	Alternative Remedial Contracting Strategy
AT	-	Averaging Time
BHC	-	Benzene Hexachloride
bgs	-	Below Ground Surface
BW	-	Body Weight
CA	-	Chemical Concentration in Air
CDD	-	Chlorodibenzo-p-dioxin
CDF	-	Chlorodibenzofuran
CDI	-	Chronic Daily Intake
CERCLA	-	Comprehensive Environmental Response, Compensation, and Liability Act
CF	-	Conversion Factor
CS	-	Chemical Concentration in Soil
CW	-	Chemical Concentration in Water
CDM Federal	-	CDM Federal Programs Corporation
CLP	-	Contract Laboratory Program
cm	-	Centimeter
cm^3	-	Cubic Centimeter
CRAVE	-	Carcinogen Risk Assessment Verification Endeavor
DDD	-	Dichlorodiphenyldichloroethane
DDE	-	Dichlorodiphenyldichloroethylene
DDT	-	Dichlorodiphenyltrichloroethane
ED	-	Exposure Duration
EE/CA	-	Engineering Evaluation/Cost Analysis
EF	-	Exposure Frequency
ERT	-	Environmental Response Team
ET	-	Exposure Time
ETU	-	Ethylene Thiourea
FI	-	Fraction Ingested
GPR	-	Ground Penetrating Radar
HEAST	-	Health Effects Assessment Summary Tables
HpCDF	-	Heptachlorodibenzofuran
hr	-	Hour
IR	-	Ingestion Rate; Inhalation Rate
IRIS	-	Integrated Risk Information System
K_{oc}	-	Organic Carbon Partitioning Coefficient
K_{ow}	-	Octanol-Water Partition Coefficient
kg	-	Kilogram
l	-	Liter

LIST OF ABBREVIATIONS (Cont'd)

LOAEL	-	Lowest-Observed-Adverse-Effect-Level
m	-	Meter
m^3	-	Cubic Meter
McLaren/Hart	-	McLaren/Hart Environmental Engineering Corporation
MCL	-	Maximum Contaminant Level
MF	-	Modifying Factor
mg	-	Milligram
MW	-	Monitoring Well
ug	-	Microgram
NCP	-	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	-	New Jersey Department of Environmental Protection
NOAEL	-	No-Observed-Adverse-Effect-Level
NPL	-	National Priority List
OCDD	-	Octachlorodibenzo-p-dioxin
PAH	-	Polycyclic Aromatic Hydrocarbon
PC	-	Chemical-Specific Dermal Permeability Constant
PCB	-	Polychlorinated Biphenyl
PCDD	-	Polychlorinated dibenzo-p-dioxin
PCDF	-	Polychlorinated dibenzofuran
PCNB	-	Pentachloronitrobenzene
PPG	-	PPG Industries, Inc.
PRG	-	Preliminary Remediation Goal
PRP	-	Potential Responsible Party
RAGS HHEM	-	Risk Assessment Guidance for Superfund - Human Health Evaluation Manual
RF	-	Respirable Fraction
RfD	-	Reference Dose
Rizzo Associates	-	Paul C. Rizzo Associates, Inc.
RME	-	Reasonable Maximum Exposure
SA	-	Skin Surface Area
SDI	-	Subchronic Daily Intake
SF	-	Slope Factor
SI	-	Site Investigation
SQL	-	Sample Quantitation Limit
SSC	-	Suspended Soil Concentration
SVOC	-	Semivolatile Organic Compound
TAL	-	Target Analyte List
TAT	-	Technical Assistance Team
TBC	-	To Be Considered
TCDD	-	Tetrachlorodibenzo-p-dioxin

LIST OF ABBREVIATIONS (Cont'd)

TCL	-	Target Compound List
TEF	-	Toxicity Equivalence Factor
TIC	-	Tentatively Identified Compound
TOX	-	Total Organic Halides
TPH	-	Total Petroleum Hydrocarbon
UCL	-	Upper Confidence Limit
UF	-	Uncertainty Factor
USEPA	-	United States Environmental Protection Agency
UST	-	Underground Storage Tank
VF	-	Soil-to-Air Volatilization Factor
VOC	-	Volatile Organic Compound
WA	-	Work Assignment
XRF	-	X-ray Fluorescence
yr	-	Year

EXECUTIVE SUMMARY

ENDANGERMENT ASSESSMENT

The Pulverizing Services site is a former pesticide formulating facility located at 332 New Albany Road in an industrial park in Moorestown, Burlington County, New Jersey. The approximately 24 acre site is comprised of three parcels of land (based upon former tax maps) approximately eight acres each in size: Areas A, B, and C. Area A is the location of the formerly active pesticide processing facility where the grinding, micronizing, densifying, blending, packaging, storing, and distribution of chemical products is reported to have occurred. In the early operations of the facility, beginning in 1935, inorganic pesticides, such as lead arsenate, calcium arsenate, sulfur, and tetrasodiumpyrophosphate were processed. In later years, organic pesticides, such as dichlorodiphenyltrichloroethane (DDT), aldrin, Malathion, dieldrin, lindane, rotenone, and Sevin were formulated. Commercial operations at the plant ceased in 1977.

During the 1950s and early 1960s, waste material is reported to have been disposed of north of the main production buildings in several trenches. Historical photographs indicate that sulfur piles existed south of Buildings 5 and 6 prior to 1963 and 1970. Historical project files report that ashes and debris from a fire which occurred in 1964 were placed in a trench north of the main production buildings.

In April 1985, the New Jersey Department of Environmental Protection (NJDEP) initiated enforcement action against Pulverizing Services. Samples were collected in 1986, confirming soil

contamination. In June 1987, the NJDEP issued an Administrative Order against the current owners of the site, PPG Industries, Inc. (PPG). During the fall of 1987, the United States Environmental Protection Agency (USEPA) performed soil sampling and a ground-penetrating radar (GPR) survey. The soil samples contained 4,4'-DDT and its breakdown products, other pesticides (including Sevin, Malathion, and various benzene hexachlorides (BHC)), arsenic, and lead. The GPR survey indicated several areas of subsurface anomalies in Area A.

Late in 1987, the USEPA took over the lead-agency role at the site. An Administrative Order on Consent was entered into by the USEPA and PPG for implementation of security fencing at the site in May 1988. On March 31, 1989, the USEPA and PPG entered into a new Order for the performance of a two-phased site investigation (SI) and engineering evaluation/cost analysis (EE/CA) of potential response actions at the site.

From December 1989 to January 1990, field activities for Phase I of the SI focused on the main plant area (Area A). Soil boring samples were collected, and ground water samples were collected from newly installed monitoring wells, in order to evaluate the extent of contamination at the site. In addition, a geophysical investigation was conducted to supplement the results of the previous GPR study.

Phase II SI field activities were initiated in October 1994 and addressed the entire site (Areas A, B, and C). For this portion of the investigation, soil (surface and at depth), ground water (via monitoring wells and the production well), surface water, and sediment (of the Building 5 trench,

storm sewer, drainage ditches, and swampy area in Area B), and sludge from the seepage pit/septic tank were sampled. Additionally, two underground storage tanks (USTs) were located and sampled.

The baseline human health risk assessment portion of this document provides quantitative estimates, in accordance with current USEPA policy and guidance, of the carcinogenic risks and noncarcinogenic health effects from human exposure to chemical contaminants in site environmental matrices in the absence of any site remediation and assuming no further institutional controls are put into place. This risk assessment process included data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty evaluation.

The ecological risk assessment portion of this document provides a preliminary assessment of the potential risks to ecological receptors from exposure to chemical contaminants in the site matrices and provides an assessment of the need for a quantitative ecological risk characterization.

The data used in this report were obtained from Phase I and Phase II SI results reported in the following documents:

- Phase I Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey (Paul C. Rizzo Associates, Inc. - Revised April 12, 1993)
- Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey (McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc. - March 27, 1995)

- Data Submittal II: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey (McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc. - May 4, 1995)

- Phase II Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey (McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc. - May 1, 1995)

Chemicals of potential concern were selected for each sampled matrix for quantitative evaluation in the risk assessment. The selected chemicals are expected to be most representative of site conditions and the greatest contributors to potential human health impacts. The chemicals of potential concern selected for each sampled matrix are presented in Table 2-24.

Exposure scenarios (i.e., receptor groups and routes of exposure) were developed for both present and potential future land uses, as appropriate. The exposure point concentration for each chemical to which a person may be exposed was estimated by using the 95 percent Upper Confidence Limit (UCL) on the arithmetic mean calculation as defined by USEPA guidance. Potential chemical intakes were then calculated using 95 percent UCL concentrations and reasonable maximum exposure (RME) variables.

The toxicity assessment presents general toxicological properties and identifies health effects criteria of selected chemicals of potential concern using the most current toxicological human health effects data. Chemicals with insufficient toxicological data were qualitatively addressed.

Carcinogenic risks and noncarcinogenic health effects were then characterized by integrating these

exposure and toxicity assessments into quantitative expressions of carcinogenic risk and noncarcinogenic hazards. The quantitative results of this risk assessment should not be construed as absolute values, but instead as estimates of potential human health impacts. By using RME variables, conservative estimates of health risks/effects within the range of possible exposures were obtained. These estimates were then compared to the acceptable USEPA target risk range of 10^{-4} to 10^{-6} for carcinogens and target level of one for noncarcinogens. The 10^{-4} to 10^{-6} target risk range may be interpreted as meaning carcinogenic risks should not be greater than approximately 1 in 10,000 to 1 in 1,000,000.

Test pit soil data were not quantitatively evaluated in this risk assessment. However, a qualitative evaluation of the data indicated concentrations of DDT and its metabolites exceeding New Jersey Soil Cleanup Criteria. The USEPA has determined that the trench disposal area test pits require remediation.

Carcinogenic risks for present area resident/trespasser exposure to surface soil in Area A via ingestion, and for potential future residential (adult and child) exposure to surface soil Areas A and C (Combined) via ingestion, to surface soil in Area B via ingestion (child), and to ground water via ingestion (adult and child) and dermal contact (adult) were in exceedance of the upper-bound of the USEPA's target risk range of 10^{-4} to 10^{-6}. Potential future site worker/employee exposure to surface soil in Area A via ingestion and to ground water via ingestion also showed carcinogenic risks in exceedance of the upper-bound of the target risk range. While soil exceedances were due mainly to the combined aldrin, dieldrin, and 4,4'-DDT risks, ground water exceedances were due mainly to the combined alpha-BHC, dieldrin, lindane (total), and arsenic

risks.

Hazard index values for present area resident/trespasser exposure to surface soil in Area A via ingestion and for potential future residential (adult and child) exposure to surface soil in Areas A and C (Combined) via ingestion, to surface soil in Area B via ingestion (child), and to ground water via ingestion were in exceedance of the USEPA's target level of one. Potential future site worker/employee exposure to surface soil in Area A via ingestion and to ground water via ingestion showed hazard index values in exceedance of one. Potential future construction worker exposure to subsurface soil in Area A and in Area B via ingestion also showed hazard index values in exceedance of one. Soil exceedances were due mainly to the combined aldrin, dieldrin, and 4,4'-DDT hazards while the ground water exceedances were due mainly to the combined dieldrin, lindane (total), arsenic, and cadmium hazards. The range of detections for the chemicals of potential concern selected in ground water were compared to Applicable or Relevant and Appropriate Requirements (ARARs), which include federal and state maximum contaminant levels (MCLs).

In accordance with standard risk assessment practice, uncertainty in risk assessment is evaluated both qualitatively and quantitatively. A quantitative evaluation, involving the calculation of central tendencies, was performed for those exposure scenarios showing carcinogenic risks or noncarcinogenic hazard index values above the USEPA target levels.

Risk-based preliminary remediation goals (PRGs), as defined by USEPA guidance, were developed for the residential and commercial/industrial land use scenarios. Carcinogen and

noncarcinogen soil PRGs were developed for aldrin, dieldrin, and 4,4'-DDT for residential and commercial/industrial combined ingestion and inhalation exposures. These PRGs are presented in Tables 7-1 and 7-2. Ground water PRGs were developed for the residential land use scenario, for those chemicals not having established MCLs. Ground water PRGs were developed for the carcinogens alpha-BHC and dieldrin and for the noncarcinogen dieldrin and are presented in Table 7-3. Available MCLs for chemicals of potential concern in ground water are presented in Table 5-4.

Finally, a summary of the results of the quantitative evaluation of potential carcinogenic risks and noncarcinogenic health effects was presented, with special note given to those results in exceedance of the USEPA target levels. Risks and hazards are discussed in detail in Section 5.0 and are summarized in Table 5-1 and 5-2.

It was determined, via the preliminary ecological risk assessment, that the potential for adverse health effects to ecological receptors exists at the Pulverizing Services Site due to site contaminants. It was recommended that a quantitative ecological assessment be conducted to determine the extent of ecological risks posed by site contamination.

BASELINE HUMAN HEALTH RISK ASSESSMENT

1.0 INTRODUCTION

1.1 Overview

Under the Alternative Remedial Contracting Strategy (ARCS II) contract, CDM Federal Programs Corporation (CDM Federal) received a work assignment, WA No. 064-2P2J, from USEPA Region II (Contract No. 68-W9-0024). Technical support included the performance of an endangerment assessment, consisting of a baseline human health risk assessment and a preliminary ecological assessment, to characterize site risk as part of CDM Federal's SI Field Oversight and Risk Assessment Activities at the Pulverizing Services site in Moorestown, New Jersey. A work plan for this assignment, based on the USEPA's work plan, was submitted by CDM Federal to the USEPA on September 1, 1994.

The specific objectives of this risk assessment, presented in Volumes I through III, are to evaluate appropriate site environmental matrices through potential human exposure routes to determine if adverse human health impacts are occurring at present and/or if they may occur in the future. This risk assessment was performed under the assumption that no additional corrective action will occur in the future (except for the test pit area soil which will be remediated).

This report was prepared in accordance with USEPA Region II and federal guidance documents and the on-line data base listed below. Additional references are listed in the reference section

at the end of the report.

- Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (RAGS HHEM) (USEPA, 1989a).
- Exposure Factors Handbook (USEPA, 1989b).
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, 1991a).
- Guidance for Data Useability in Risk Assessment (USEPA, 1992a).
- Dermal Exposure Assessment: Principles and Applications (USEPA, 1992c).
- Health Effects Assessment Summary Tables FY 1994-Annual (USEPA, 1994).
- Integrated Risk Information System On-line Data Base of Toxicity Measures (USEPA, 1995).

1.2 Site Background

The Pulverizing Services site is located in an industrial park at 332 New Albany Road in Moorestown, Burlington, New Jersey (Figure 1) and is bordered by light industrial, commercial, and residential properties. The site is comprised of three parcels of land: Areas A, B, and C (Figure 2). From about 1935 to 1977, the Pulverizing Services site was operated as a pesticide formulating facility. Originally operated by the International Pulverizing Company, the plant was sold to the Micronizer Company in 1946. PPG purchased the Micronizer Company in 1948 and operated the plant until 1963 when the plant was sold to Pulverizing Services, Incorporated. In January 1977, operations at the site ceased.

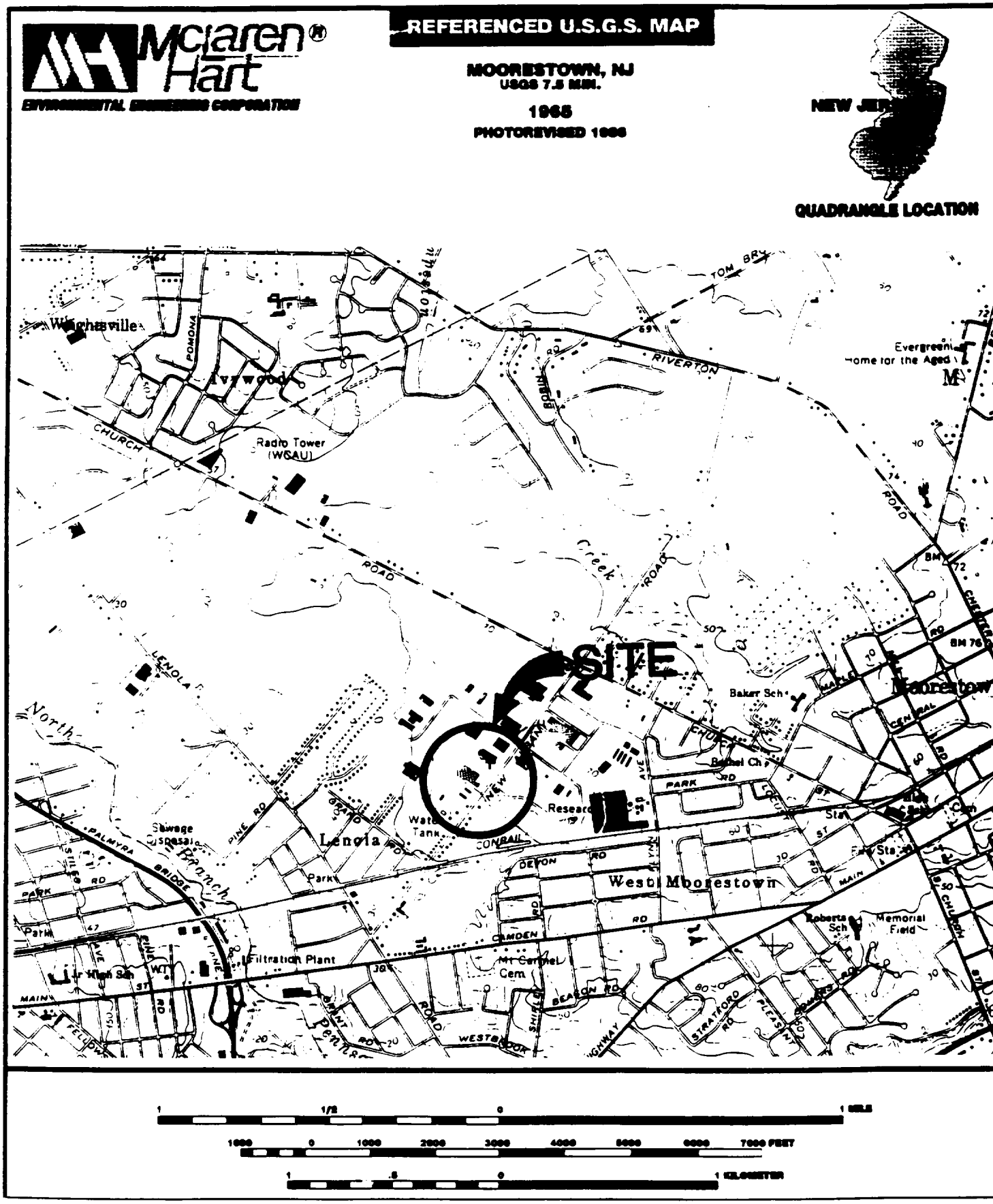

FIGURE 1

Site Location Map

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 1, "Site Location Map", Phase II Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, May 1, 1995.

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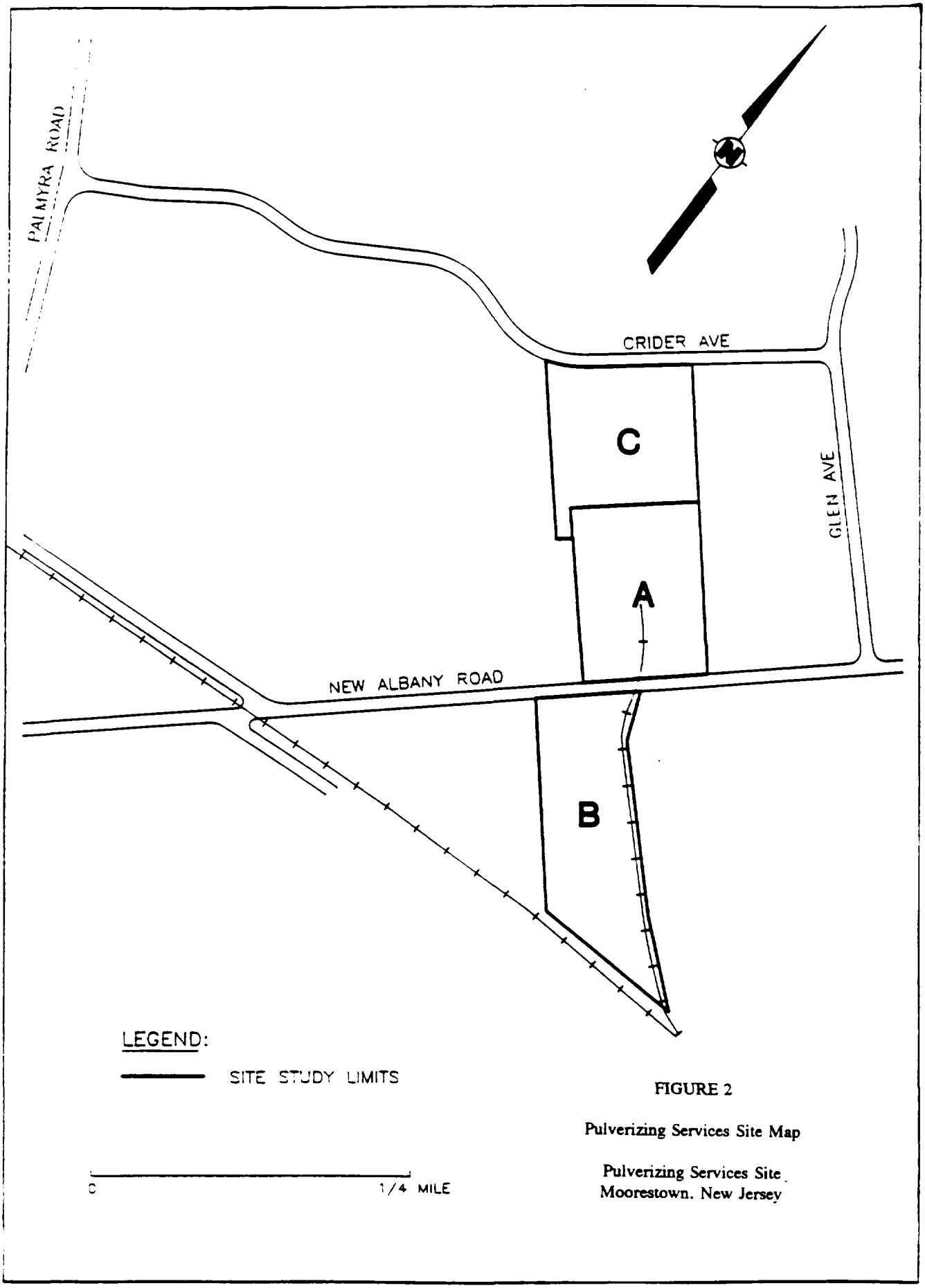


FIGURE 2

Pulverizing Services Site Map

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No.2, "Site Plan", Phase I Site Investigation Report, Pulverizing Services Site, New Jersey, Revision 2, Paul C. Rizzo Associates, Inc., August 12, 1993.

Active ingredients of pesticides were not actually manufactured at the site, but were brought to the site, and then ground, blended, and packaged for distribution under the labels of various companies. Inorganic pesticides (including lead arsenate, calcium arsenate, sulfur, and tetrasodium pyrophosphate) were originally formulated at the site. This was followed by the formulation of organic pesticides, including dichlorodiphenyltrichloroethane (DDT), aldrin, Malathion, dieldrin, lindane, rotenone, and n-methyl carbamate (Sevin).

In April 1986, the site was sampled by a team from the New Jersey Department of Environmental Protection (NJDEP). Surface soil and drainage ditch sediment samples were collected, as were samples from floor sweepings from a building and from a building floor drain. Various pesticides and organic chemicals were detected. The NJDEP documented the presence of pesticides in soil from the landfill area, specifically, 4,4'-DDT, 4,4'-DDD, and alpha-BHC, and in June 1987, issued an Administrative Order against PPG.

Soil sampling and analysis performed by the USEPA's Technical Assistance Team (TAT) in October 1987 verified the NJDEP results and revealed widespread occurrences of pesticides in Area A of the site. Soils were also found to contain pesticides in areas which, based upon historical photographs and records, were believed not to have been used by the facility (Areas B and C). Additionally, a small drainage ditch originating in Area A and draining along Area C into a storm sewer, was considered a potential migration pathway of pesticides offsite.

Late in 1987, the USEPA took over the lead-agency role at the site. The USEPA Environmental

Response Team (ERT) performed a ground-penetrating radar (GPR) study and collected soil samples. The GPR study indicated numerous areas of disturbance north and west of Building 29 which were apparently trenches used for disposal of pesticide wastes and other materials associated with site operations. The soil samples were collected at 14 locations based on the presence of dead vegetation, GPR anomalies, and visible wastes. Samples were obtained at the surface and at several locations at depths of one, three, and five feet. The soil samples contained 4,4'-DDT and its breakdown products, as well as arsenic and sulfur. These chemicals were found in high concentrations in surface and in one-foot deep samples. Significant concentrations of the chemicals were found in deeper samples at two locations, indicating that mixing may have occurred during trench disposal of these wastes.

An Administrative Order on Consent was entered into in May 1988 between the USEPA and PPG for the implementation of security fencing at the site. On March 31, 1989, the USEPA and PPG entered into a new Order for the performance of a two-phase SI and EE/CA of potential response actions at the site.

Phase I of the SI focused on the main plant area (Area A) and was initiated in November 1989. Soil boring samples were collected, and ground water samples were collected from newly-installed monitoring wells, in order to evaluate the extent contamination at the site. In addition, a geophysical investigation was conducted to supplement the results of the previous GPR study.

Phase II SI field activities were initiated in October 1994 and addressed the entire site (Areas A,

B and C). For this portion of the investigation, soil (surface and at depth), ground water (via monitoring wells and the production well), surface water and sediment (of the Building 5 trench, storm sewer, drainage ditches, and swampy area in Area B), and sludge from the seepage pit/septic tank were sampled. Additionally, two USTs were located and sampled.

Data from Phase I and II SI activities have been evaluated in this human health risk assessment report.

1.3 Scope of the Risk Assessment

The baseline risk assessment presents an evaluation of the potential risks and hazards to human health that may exist at the site currently and in the future in the absence of any further remediation. The assessment is based on site data generated during the Phase I SI field activities conducted from December 1989 through January 1990 and during the Phase II SI field activities conducted from October 1994 to March 1995.

The baseline risk assessment was prepared utilizing, to the maximum extent possible, site-specific data to define sources, pathways, receptors, chemical concentrations and exposure input terms. Where specific data were not available, professional judgement was used to select input terms that are assumed to reflect actual site conditions. By having an adequate data base, the need for using conservative sources, pathways, receptors, chemical concentrations, and exposure input terms has been minimized.

1.4 Organization of the Risk Assessment

Data Collection and Evaluation

In the first step of the risk assessment, Data Collection and Evaluation, a subset of the various chemicals identified in each environmental matrix (i.e., soil, air, ground water) was selected for detailed analysis. The primary selection criteria for these chemicals included 1) the chemical concentrations in various media; 2) a chemical concentration-toxicity screen; 3) the frequencies of detection; 4) the physical/chemical parameters; 5) the degree of toxicity, mobility, and persistence in the environment; and 6) historical information about site activities and the chemicals reliably associated with these activities. Section 2.0 of this risk assessment presents Data Collection and Evaluation. All site sample data collected as part of Phase I and Phase II SI field activities conducted between 1989 and 1995 are presented in Appendix E of this report.

Exposure Assessment

In the second step, Exposure Assessment, qualitative or quantitative estimates of the magnitude, frequency, duration, and routes of exposure were made. Numerous pathways through which chemical contaminants could possibly migrate from potential sources to existing receptors were identified. Receptor groups (i.e., human populations) that might potentially be exposed as a result of the presence of one or more chemicals in the environment were also identified. Typically, these receptor populations include persons who might be exposed via ingestion of, dermal contact

with, or inhalation of a contaminated medium, such as surface soil. Receptors who might be exposed under present or potential future land or water use scenarios were evaluated, as appropriate.

Exposure point concentrations for chemicals of potential concern were estimated based on the 95 percent Upper Confidence Limit (UCL) on the arithmetic mean (Appendix A). However, if the maximum site detection for a chemical was lower than the 95 percent UCL concentration, the actual maximum site detection was utilized in the estimation of chemical intakes.

Daily chemical intakes via ingestion, dermal contact or inhalation routes were quantitatively evaluated based on the 95 percent UCL estimate and site-specific, medium-specific, and receptor-specific intake variables. Both chronic and subchronic daily intakes were estimated in the risk assessment depending on the length of exposure and the specific receptor population being evaluated (i.e., construction worker subsurface soil exposure is a short-term subchronic exposure, while all others are longer, chronic exposures). As previously stated, exposures were estimated for the reasonable maximum case exposure scenario (RME) which employs the 95 percent UCL (exposure point) concentration and RME assumptions. The RME is the highest exposure that is reasonably expected to occur at a site. It should be noted that the risk assessment assumes that no reduction in exposure concentrations occurs due to natural physical/chemical processes, site remediation or institutional controls. The results of this evaluation are provided in the Exposure Assessment section (3.0) of the risk assessment.

Toxicity Assessment

The third step of the risk assessment consisted of the Toxicity Assessment. The purpose of the toxicity assessment was to weigh available toxicological evidence regarding the potential for a particular chemical contaminant to cause adverse health effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical contaminant and the increased likelihood and/or severity of adverse health effects (USEPA, 1989a).

The USEPA has performed the toxicity assessment step for numerous chemicals and has made available the resulting toxicity information and toxicity values, which have undergone extensive peer review; however, data analysis and interpretation are still required. These established toxicity values were obtained from the Integrated Risk Information System (IRIS) data base which is updated monthly, or from the Health Effects Assessment Summary Tables (HEAST) FY 1994 - Annual if no value was present in IRIS. The Superfund Health Risk Technical Support Center was consulted for numerous specific chemical toxicity values (i.e., trichloroethene), as directed by HEAST, when no value was presented.

A toxicity profile for each chemical of potential concern was developed using USEPA toxicity assessments and accompanying values. When toxicity values were not available for a specific chemical, the chemical was qualitatively discussed. The toxicity values and the limitations of use of the toxicity values have been described in the Toxicity Assessment section (4.0) of the risk

assessment. Toxicological profiles are presented in Appendix B.

Risk Characterization

In the last step of the risk assessment process, Risk Characterization, the chronic or subchronic daily intake for each chemical to which a given receptor group might be exposed was compared with concentrations known or suspected to present some health risk or hazard. Quantitative estimates of the carcinogenic risks and noncarcinogenic health effects associated with each exposure pathway are presented for present and potential future land uses of the site.

The risks resulting from exposures to carcinogens were estimated based on the following assumptions:

- a linear relationship exists between the intake of a carcinogenic substance over a lifetime and the risk of cancer (the linearized multistage model of carcinogenesis); and
- cancer risks from exposures to all carcinogens via all intake routes are additive.

The potential for noncarcinogenic effects was evaluated by comparing an exposure level over a specified time period with a reference dose derived for a similar exposure period. Section 5.0 of this risk assessment presents the Risk Characterization. Spreadsheet calculations are presented in Appendix C.

Due to the number of assumptions that are required during the risk assessment process, there is inevitably some degree of uncertainty associated with the risk and hazard estimates. These uncertainties have been addressed both qualitatively and quantitatively (i.e., central tendency calculations) in Section 6.0, Uncertainties in Risk Assessment. Central tendency calculations are presented in Appendix D of this report.

Risk-based preliminary remediation goals (PRGs) are initial concentration goals for individual chemicals for specific medium and land use combinations. Whether PRGs are required for a site depends on the calculated site risk and hazard estimates, the existence of ARARs, and the existence of superseding USEPA guidance on action levels. Generally, if risk and hazard estimates do not exceed the USEPA target risk range of 10^{-4} to 10^{-6} for carcinogens or one for noncarcinogens, and PRGs are clearly defined by ARARs, PRGs need not be calculated for the site. PRGs for this site are presented and discussed in Section 7.0.

The ecological risk assessment is presented in Section 8.0. A summary of the results of the baseline human health risk assessment and the ecological assessment is presented in Section 9.0.

A list of the references used in producing this endangerment assessment is presented in Section 10.0.

2.0 DATA COLLECTION AND EVALUATION

Field investigations conducted by Paul C. Rizzo Associates, Inc. (Rizzo Associates) and McLaren/Hart Environmental Engineering Corporation (McLaren/Hart) from 1989 to 1995 for PPG, the site's potential responsible party (PRP), serve as the sources of information for the site characterization and analytical data for this risk assessment. The investigations include the:

- Phase I Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey (Paul C. Rizzo Associates, Inc. - Revised April 12, 1993).
- Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey (McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc. - March 27, 1995)
- Data Submittal II: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey (McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc. - May 4, 1995)
- Phase II Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey (McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc. - May 1, 1995)

This section presents a summary of the results of the sampling and analysis activities conducted to characterize conditions at the Pulverizing Services site. The results of these activities are presented along with the criteria used to identify chemicals of potential concern and a list of chemicals of potential concern selected on the basis of these criteria.

All site environmental data, including tentatively identified compound (TIC) data, which were evaluated and/or utilized in this assessment are presented in Appendix E of this report. The PRP

could not provide Form I's blank data, and TIC data for Phase I SI results, therefore, these results were not evaluated in this risk assessment. The sampling results have been summarized in tabular form for surface soil, subsurface soil, ground water, surface water, and sediment groupings as follows: surface soil (Area A, Area B, Area C, and Area A and Area C (Combined)), subsurface soil (Area A and Area B), subsurface screening data for DDT and metabolites and selected metals (Area C), ground water (on-site), and surface water (drainage from Area A through Area C and from Area A through Area B), sediment (drainage from Area A through Area C and from Area A through Area B) and test pit data. These tables, with the exception of screening data and test pit data, are presented in Section 2.2. Screening data and test pit data are included in Appendix E, Site Data. Each data summary table presents all chemicals detected, the associated frequencies and ranges of detected concentrations, the locations of the maximum detected concentrations, and the ranges of sample quantitation limits for nondetects. Data are segregated by locations considered to be potentially impacted by the site (i.e., onsite) and by locations that may be representative of background (i.e., offsite). It should be noted that only one air sample was collected at the site. The results from this sample are presented in Appendix E Site Data.

All soil, air, ground water, surface water, and sediment sample data, including TIC data obtained during the SI, were validated in accordance with USEPA Region II protocols. All data qualifiers have been included in the data summary tables for completeness.

Data collected from media for which the potential for exposure exists (i.e., soil, surface water, sediment, and ground water) formed the basis of the quantitative risk assessment. These data were

used to estimate exposure point concentrations as discussed in Section 3.3 and carcinogenic risk and noncarcinogenic hazard estimates as presented in Section 5.0.

2.1 Summary of Sampling and Analysis Activities

Phase I SI field activities were conducted by Rizzo Associates, PPG's former contractor, from December 1989 through January 1990. As part of the Phase I SI activities, Rizzo Associates conducted a geophysical survey, installed/developed monitoring wells, and, sampled soil, ground water, and sediment. The majority of samples were analyzed for Target Compound List (TCL) pesticides/polychlorinated biphenyls (PCBs), Sevin, Malathion, pentachloronitrobenzene (PCNB), and Target Analyte List (TAL) metals/cyanide. Some of the soil samples and all of the sediment sample were additionally analyzed for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), referred to as "dioxins" and "furans". Although split samples were accepted by CDM Federal, these results have not been included in the risk assessment.

Phase II SI field activities were conducted by McLaren/Hart, PPG's current contractor, between October 1994 and March 1995. As part of the Phase II SI activities, McLaren/Hart performed field screening analysis of soils, installed/developed monitoring wells, conducted a downhole geophysical survey, well decommissioning, excavated/sampled test pits, and sampled soil, ground water, surface water, sediment, air, and USTs.

Soil samples of the Phase II SI activities were initially field screened using an immunoassay test kit to analyze for total chlorinated compounds and x-ray fluorescence (XRF) analysis to quantify select metals (arsenic, cadmium, chromium, and lead). Field screening methods were used to rapidly assess the extent of potentially site-related constituents. The field screening data were used as a guide in determining additional subsequent surface and subsurface soil sampling locations. These field screening results were also used to identify which soil aliquots were to be submitted for USEPA Contract Laboratory Program (CLP) analysis.

The majority of samples sent for USEPA CLP analysis were analyzed for TCL organics, including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/PCBs, Sevin, Malathion, selected metals (arsenic, cadmium, chromium, and lead), hexavalent chromium, and total organic halogens (TOX). Some soil and sediment samples were additionally analyzed for dioxins, herbicides (via USEPA method 8150), rotenone, and/or (PCNB). Composite soil samples were analyzed for dioxins and furans only. The single air sample was analyzed for TCL pesticides only. Product samples from USTs were analyzed for total petroleum hydrocarbons (TPHs) and TCL pesticides but have not been utilized in the risk assessment. During the Phase II SI activities, CDM Federal accepted splits of soil and ground water samples for TCL and TAL analyses. However, split sample results have not been included in this risk assessment.

Surface soil samples were considered 0 to 0.5 feet in depth as collected from the ground surface. Subsurface soil refers to all soils that are below surface soil. Subsurface soil samples 0.5 to 12 feet in depth were used in the risk assessment, as this is the zone of soils that may be accessed

during present and potential future excavation activities.

The environmental media that were sampled and that have been quantitatively evaluated in this risk assessment include surface soil, subsurface soil, ground water, surface water, and sediment. Product sample results from USTs have not been included in this risk assessment. The single air sample result has not been quantitatively evaluated in this risk assessment, but is discussed below for completeness. The following is a summary of specific data sets for soil, ground water, surface water, and sediment used in the evaluation of potential human health risks and hazards.

2.1.1 Soil

Historical information suggests that most industrial activity occurred in Area A when the facility was operational. Analytical data indicate that Area A is more chemically contaminated than Areas B and C. While Areas A and C are contiguous, Area B is separated from these Areas by a roadway. For this risk assessment, soil borings and their associated samples are grouped according to their locations within Areas A, B, or C. Background (offsite) samples were not used in this risk assessment as they appeared to have elevated levels of inorganics and organics.

The six surface soil samples from the Phase I SI activities were collected at too great a depth range (0.5 to 2 feet below ground surface [bgs]) to be considered as surface soil. Therefore, only the surface soil samples from Phase II SI activities have been included in the risk assessment. As

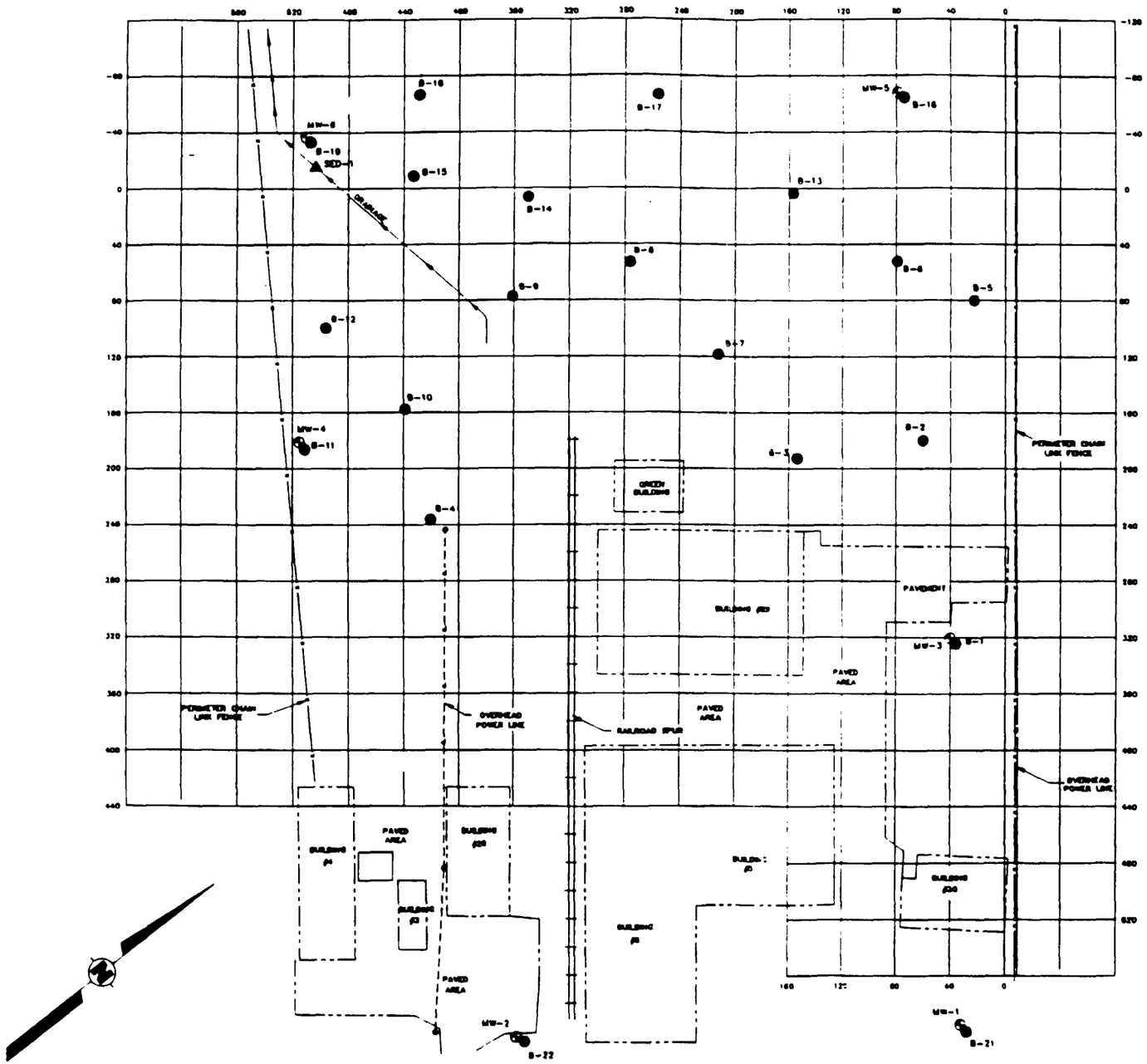
discussed in Section 2.1, the sample depth considered for the risk assessment to represent surface soils will be 0 to 0.5 feet bgs.

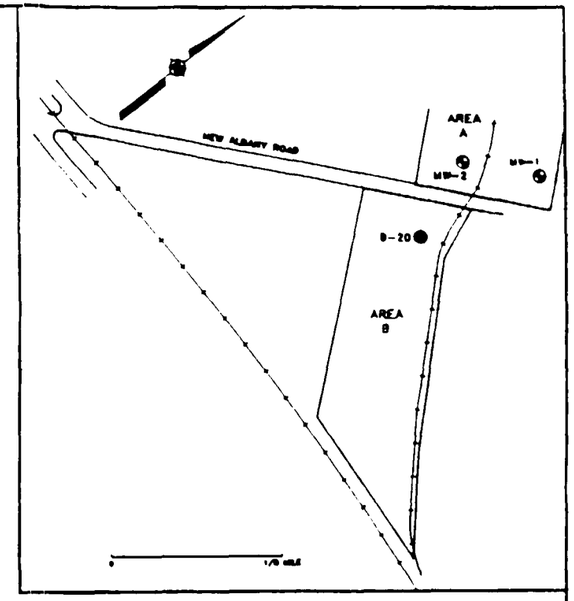
Subsurface soil data from both Phase I and Phase II activities have been treated together. As discussed in Section 2.1, the sample depth considered to represent subsurface soils is 0.5 to 12 feet bgs.

Phase I

Soil Borings: As part of the Phase I SI, Rizzo Associates collected both surface soil and subsurface soil samples from soil borings in Area A. Soil boring locations are presented in Figure 3. Six surface soil boring samples (0 to 2 feet bgs) and 40 subsurface soil boring samples (20 at intermediate depth from approximately 5 to 7 feet bgs and 20 at deep depth from approximately 10 to 12 feet bgs) were analyzed for TCL pesticides/PCBs, Sevin, Malathion, PCNB, and TAL metals and cyanide. As discussed above, the six "surface" soil samples (0 to 2 feet bgs) have not been used in the risk assessment. Nine intermediate depth samples ranging from 4 to 8 feet were collected at soil boring locations B-1, B-2, B-6, B-7, B-8, B-11, B-19, and B-20 and were additionally analyzed for dioxins.

Hand Collected Soil Samples: During Phase I, six additional subsurface soil samples were collected at approximately an 8 inch depth from four locations around soil boring B-20 using shovel and trowel. These additional soil samples are identified as SS-1, SS-2, SS-3A, SS-3B, SS-





LEGEND:

- B-3 SOIL BORING
- MW-1 SHALLOW MONITORING WELL
- SED-1 SEDIMENT SAMPLING LOCATION

SCALE
40 0 40 80 FEET

FIGURE 3

Phase I Soil Boring Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 12, "Location of Borings and Monitoring Wells", Phase I Site Investigation Report, Pulverizing Services Site, New Jersey, Revision 2, Paul C. Rizzo Associates, Inc., August 12, 1993.

4A, and SS-4B and were analyzed for TCL pesticides/PCBs, Sevin, Malathion, and PCNB. Figure 4 shows the locations at which these additional samples were collected.

Phase II

As part of the Phase II SI, surface soil samples (from soil borings and composite soil sampling) and subsurface soil samples (from soil boring and test pits) were collected by McLaren/Hart.

Soil Borings: A total of 96 soil boring locations were sampled as shown on Figure 5. Samples from these borings were collected using Geoprobe® and hand augering techniques.

Although field screening data are available for over 255 samples from the 96 boring locations, these data do not meet data quality objectives for risk assessment and will not be used other than qualitatively in absence of quantitative data.

A total of 39 soil samples and 11 duplicates were collected from 33 soil boring locations in Areas A, B, and C. These soil samples were analyzed for the following:

- 24 samples were analyzed for TCL organics, Sevin, Malathion, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, hexavalent chromium, and TOX.
- 13 samples were analyzed for TCL SVOCs, TCL pesticides/PCBs, Sevin, Malathion, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, hexavalent chromium, and TOX.

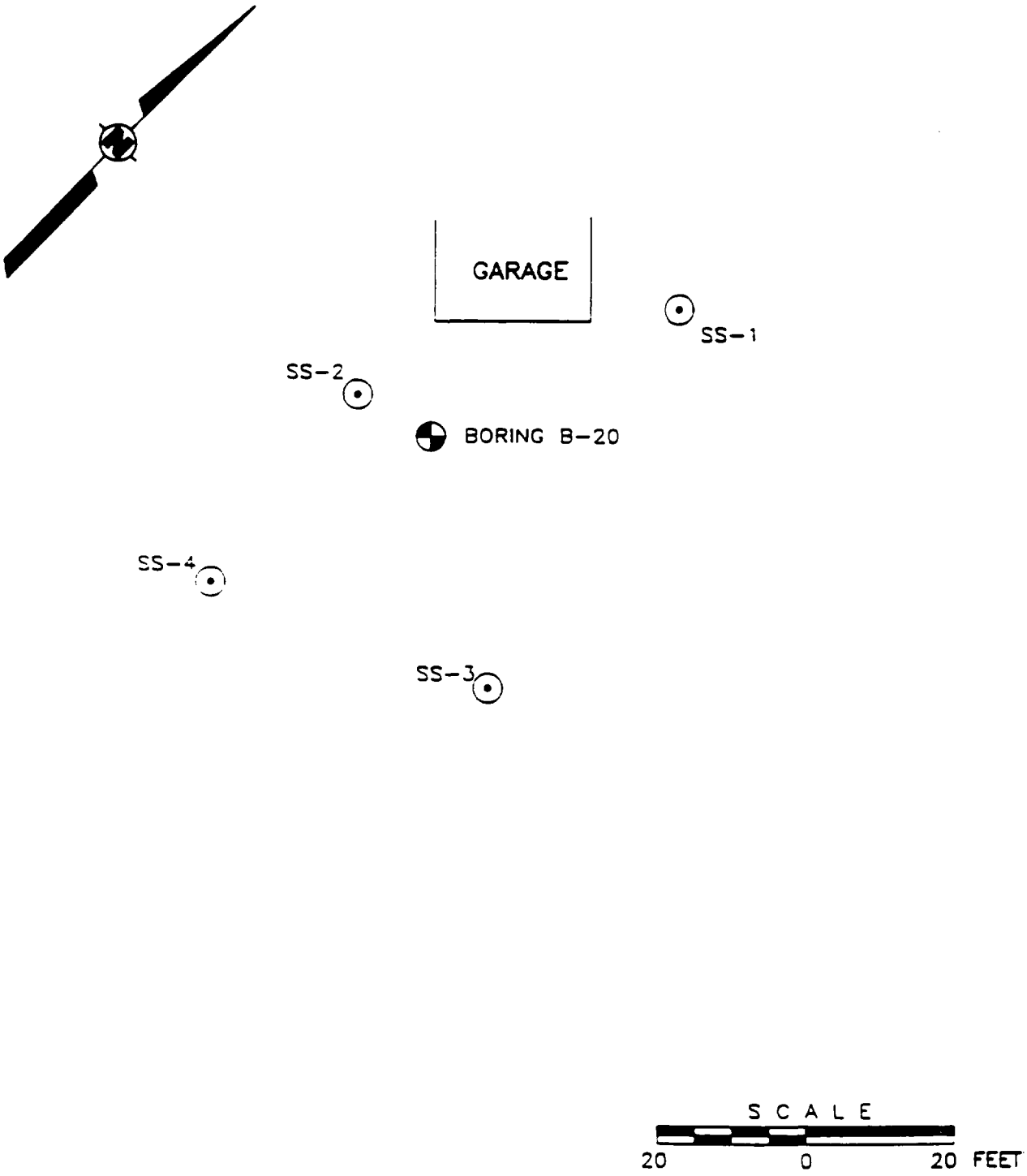


FIGURE 4

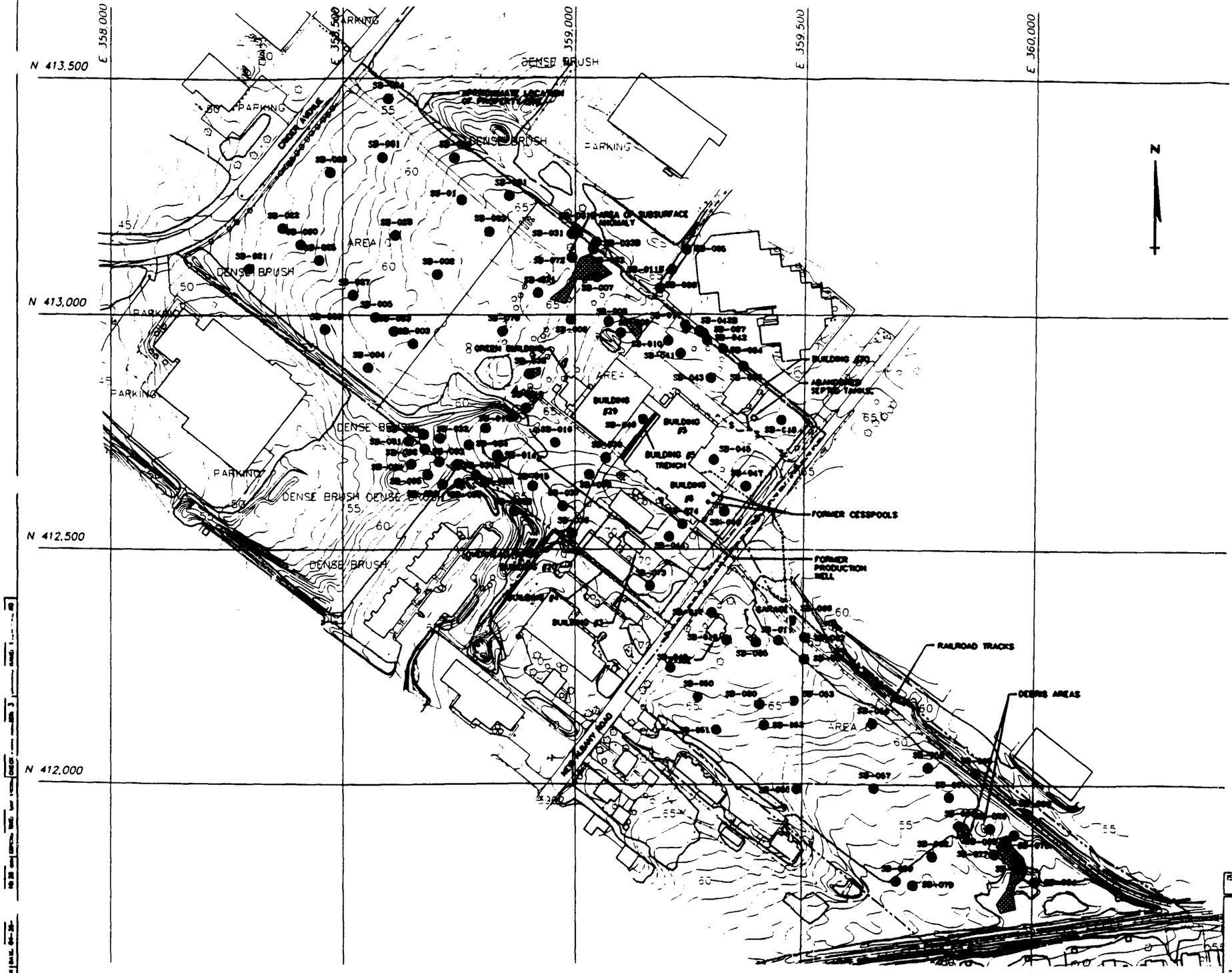
Additional Phase I Soil Sample Locations

Pulverizing Services Site
Moorestown, New Jersey

REVISIONS
1 REVISED PER USEPA COMMENTS DATED JULY 1, 1993.
APPROVED BY: DATE: 8-12-93

Source: Figure No. 15, "Location of Surface Soil Samples near Boring B-20", Phase I Site Investigation Report, Pulverizing Services Site, New Jersey, Revision 2, Paul C. Rizzo Associates, Inc., August 12, 1993. 1

700045



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DRAIN LINE
- SB-067 ● SOIL SAMPLE LOCATION
- VEGETATED AREA

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE
0 100 200 300 FEET

ISSUE DATE: 5/1/95

DATE

8500 BROOKTREE ROAD
SUITE 300
WEXFORD, PA 15090

FIGURE 5

Phase II Soil Boring Locations

Pulverizing Services Site
Moorestown, New Jersey

700046

Source: Figure No. 4, "Soil Boring Locations", Phase II Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, May 1, 1995.

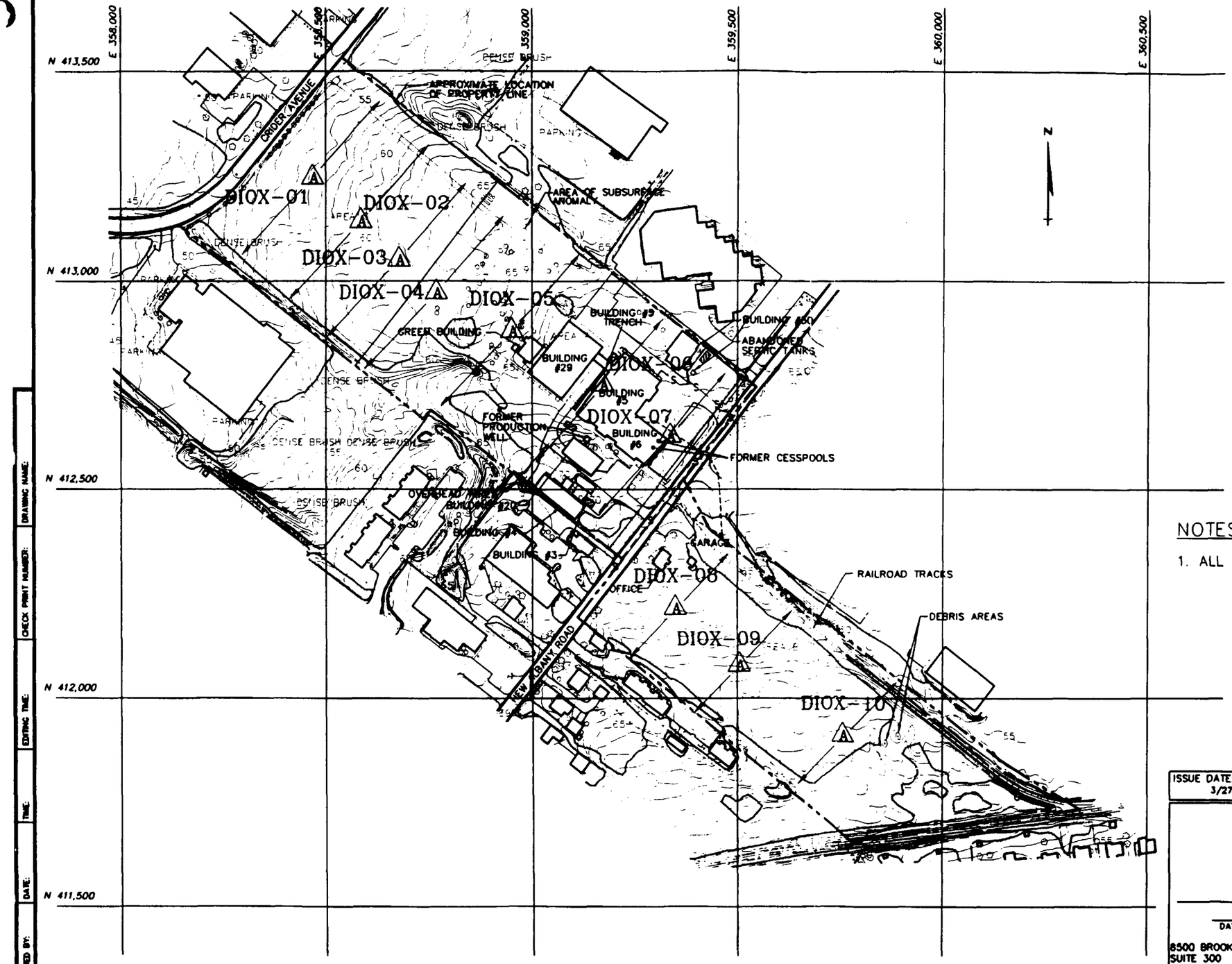
- One sample was analyzed for TCL VOCs, TCL SVOCs, hexavalent chromium, and TOX.

- One sample was analyzed for selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010.

Although five split soil boring samples were collected by CDM Federal, these results have not been included in the risk assessment.

A total of nine soil samples were collected from soil borings in offsite locations. These samples are SB-034B/0-0.5, SB-84/1-2, SB-85/0-0.5, SB-88/0-0.5, SB-90/1-1.5, SB-93/0-0.5, SB-94/0-0.5, SB-95/1-2, and SB-96/0-0.5. One sample (SB-034B/0-0.5) was analyzed for TCL SVOCs, TCL pesticides/PCBs, Sevin, Malathion, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, hexavalent chromium, and TOX. The remaining eight samples were analyzed for TCL pesticides/PCBs, Sevin, Malathion, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, and hexavalent chromium.

Composite Samples: A total of ten composite surface soil samples (DIOX-01 through DIOX-10; 0 to 0.5 feet bgs) were collected from ten transects by McLaren/Hart and analyzed for dioxins. Figure 6 identifies the transect locations. Four transect locations were located in Area A (DIOX-04, DIOX-05, DIOX-06, and DIOX-07 with corresponding samples DIOX-1-A, DIOX-2-A, DIOX-3-A, and DIOX-4-A), three in Area B (DIOX-08, DIOX-09, and DIOX-10 with



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE

DIOX-08

(A) COMPOSITE SAMPLE LOCATIONS

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

0 250 500 750 FEET

DRAWING NAME:
CHECK PRINT NUMBER:
EDITING TIME:
TIME:
DATE:
EDITED BY:

ISSUE DATE: 3/27/95

DATE

8500 BROCKTREE ROAD
SUITE 300
WEXFORD, PA. 15090

FIGURE 6

Composite Soil Sample Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 7, "Composite Sample Locations", Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, March 27, 1995.

700048

corresponding samples DIOX-1-B, DIOX-2-B, and DIOX-3-B), and three in Area C (DIOX-01, DIOX-02, and DIOX-03 with corresponding samples DIOX-1-C, DIOX-2-C, and DIOX-3-C). For risk assessment purposes, the composite samples have been grouped by Area with the surface soil results.

Test Pit Samples: Eight subsurface soil and two duplicate samples were collected from the test pits, which were located in known disposal areas. The test pit data are discussed in the text under risk characterization section.

The surface and subsurface soil sample groupings evaluated in this risk assessment are presented in Tables 2-1 through 2-4 and 2-5 through 2-6, respectively.

2.1.2 Air

As part of the Phase II SI field activities, one air sample was collected during test pit excavation activities and analyzed for TCL pesticides. This air sample is only qualitatively addressed in this risk assessment. Figure 7 identifies the Area A air sampling locations.

2.1.3 Ground Water

As part of the Phase I SI activities, six ground water samples were collected from monitoring wells MW-1 through MW-6 by Rizzo Associates in January 1991. Figure 8 identifies the sampled

TABLE 2-1
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREA A

07/11/1995
9:13 AM

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
PHENOL	ug/kg	3 / 14	410.00 - 36000.00	SB-36/0.5-AV	121.50 UJ - 7800.00 U
HEXACHLOROBENZENE	ug/kg	2 / 14	310.00 J - 200000.00 D	SB-07-0-0.5	40.50 UJ - 9100.00 U
DI-N-BUTYLPHTHALATE	ug/kg	1 / 14	312.50 B - 312.50 B	SB-06-0-0.5-AV	380.00 U - 7800.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
LINDANE, TOTAL	ug/kg	1 / 14	33000.00 J - 33000.00 J	SB-07-0-0.5	40.00 U - 20000.00 U
ALDRIN	ug/kg	1 / 14	69000.00 J - 69000.00 J	SB-07-0-0.5	40.00 U - 20000.00 U
ENDOSULFAN I	ug/kg	1 / 14	43.75 - 43.75	SB-40/0.5-AV	9.20 UJ - 80000.00 U
DIELDRIN	ug/kg	6 / 13	750.00 J - 2200000.00	SB-07-0-0.5	77.00 UJ - 7700.00 UD
4,4'-DDE	ug/kg	11 / 14	280.00 - 24000.00 J	SB-10-0-0.5	680.00 U - 42000.00 UJN
ENDRIN, TOTAL	ug/kg	1 / 14	355.00 X - 355.00 X	SB-40/0.5-AV	79.00 U - 40000.00 U
4,4'-DDD	ug/kg	11 / 14	350.00 JN - 360000.00 JN	SB-07-0-0.5	48.00 UJN - 7300.00 UJ
4,4'-DDT	ug/kg	14 / 14	2500.00 D - 6800000.00 D	SB-07-0-0.5	-- - --
METHOXYCHLOR	ug/kg	1 / 14	4900.00 X - 4900.00 X	SB-40/0.5-AV	57.50 UJ - 800000.00 U
ENDRIN KETONE	ug/kg	1 / 14	80000.00 J - 80000.00 J	SB-07-0-0.5	80.00 U - 40000.00 U
SEVIN	ug/kg	5 / 14	41.00 - 510.00	SB-13-0-0.5	33.00 UU - 250.00 U
MALATHION	ug/kg	3 / 14	23.00 P - 260.00 P	SB-10-0-0.5	17.00 UU - 170.00 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	9 / 12	2345.00 - 12300.00	SB-09-0-0.5	53.00 U - 53.00 U
ARSENIC	mg/kg	15 / 15	2.20 - 132.00	SB-07-0-0.5	-- - --
BARIUM	mg/kg	8 / 12	38.80 B - 79.00	SB-13-0-0.5	28.60 UB - 35.00 U
BERYLLIUM	mg/kg	2 / 12	0.36 B - 1.80	SB-10-0-0.5	0.23 U - 0.23 U
CADMIUM	mg/kg	4 / 15	1.60 - 6.30	SB-35/0-0.5	0.20 U - 0.91 U
CALCIUM	mg/kg	9 / 12	79.80 B - 9600.00	SB-09-0-0.5	79.00 U - 79.00 U
CHROMIUM	mg/kg	15 / 15	5.30 - 96.50	SB-35/0-0.5	-- - --
CHROMIUM (HEXAVALENT)	mg/kg	2 / 14	1.15 J - 2.20 J	SB-118(0-0.5)	1.00 UJ - 1.00 UJ
COBALT	mg/kg	5 / 12	2.00 B - 4.90 B	SB-15-0-0.5	0.65 UB - 2.00 U
IRON	mg/kg	9 / 12	9430.00 - 62200.00	SB-10-0-0.5	10.00 U - 10.00 U
LEAD	mg/kg	15 / 15	17.60 - 480.50 J	SB-36/0.5-AV	-- - --
MAGNESIUM	mg/kg	9 / 12	197.50 B - 5140.00	SB-09-0-0.5	20.00 U - 20.00 U
MANGANESE	mg/kg	6 / 12	32.60 - 331.00	SB-09-0-0.5	12.30 U - 20.00 U
MERCURY	mg/kg	6 / 12	0.13 - 0.94	SB-13-0-0.5	0.12 U - 0.12 U
NICKEL	mg/kg	7 / 12	5.00 B - 9.80	SB-13-0-0.5	2.60 UB - 5.00 U
POTASSIUM	mg/kg	9 / 12	442.00 B - 1070.00 B	SB-15-0-0.5	20.00 U - 20.00 U
SELENIUM	mg/kg	4 / 12	0.72 B - 15.20	SB-13-0-0.5	0.90 U - 0.90 U
SODIUM	mg/kg	9 / 12	169.00 B - 375.00 B	SB-09-0-0.5	10.00 U - 10.00 U
THALLIUM	mg/kg	3 / 12	0.95 B - 2.30	SB-10-0-0.5	1.00 U - 1.00 U
VANADIUM	mg/kg	9 / 12	10.10 B - 33.80	SB-15-0-0.5	5.00 U - 5.00 U
ZINC	mg/kg	9 / 12	8.85 - 88.50	SB-09-0-0.5	5.00 U - 5.00 U

TABLE 2-1 (CONT'D)
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREA A

07/11/1995
9:13 AM

Fungicides	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
SB-06-0-0.5-AV, SB-07-0-0.5, SB-08-0-0.5, SB-09-0-0.5, SB-10-0-0.5, SB-11-0-0.5-AV, SB-11B(0-0.5), SB-12
SB-13-0-0.5, SB-14-0-0.5, SB-15-0-0.5, SB-35/0-0.5, SB-36/0.5-AV, SB-40/0.5-AV, SB-46/0.5-AV.

Dioxin	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
OCTACHLORODIBENZO-P-DIO ug/kg	4 / 4	2.70 J - 12.00	DIOX-2-A	-- - --

SAMPLE GROUP:
DIOX-1-A, DIOX-2-A, DIOX-3-A, DIOX-4-A (Sample locations DIOX-4, DIOX-5, DIOX-6, DIOX-7).

TABLE 2-2
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREA B

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
FLUORANTHENE	ug/kg	1 / 7	3550.00 - 3550.00	SB-66/0.5-AV	57.50 UJ - 3900.00 U
PYRENE	ug/kg	1 / 7	2950.00 - 2950.00	SB-66/0.5-AV	65.50 UJ - 3900.00 U
BENZO (A) ANTHRACENE	ug/kg	1 / 7	2050.00 - 2050.00	SB-66/0.5-AV	72.00 UJ - 3900.00 U
CHRYSENE	ug/kg	1 / 7	3000.00 - 3000.00	SB-66/0.5-AV	84.00 UJ - 3900.00 U
BENZO(B)FLUORANTHENE	ug/kg	2 / 7	360.00 - 4850.00	SB-66/0.5-AV	95.00 UJ - 3900.00 U
BENZO(K) FLUORANTHENE	ug/kg	1 / 7	1700.00 - 1700.00	SB-66/0.5-AV	34.00 UJ - 3900.00 U
BENZO (A) PYRENE	ug/kg	1 / 7	1300.00 - 1300.00	SB-66/0.5-AV	64.00 UJ - 3900.00 U
INDENO (1,2,3-CD) PYREN	ug/kg	1 / 7	975.00 - 975.00	SB-66/0.5-AV	46.00 UJ - 3900.00 U
BENZO (G,H,I) PERYLENE	ug/kg	1 / 7	547.50 - 547.50	SB-66/0.5-AV	48.00 UJ - 3900.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
BETA-BHC	ug/kg	1 / 7	305.00 - 305.00	SB-54/0.5-AV	20.00 U - 500.00 UJ
ENDOSULFAN I	ug/kg	1 / 7	417.50 - 417.50	SB-54/0.5-AV	8.60 UJ - 670.00 UJ
4,4'-DDE	ug/kg	7 / 7	150.00 - 20000.00	SB-19-0-0.5	-- - --
4,4'-DDD	ug/kg	6 / 7	150.00 JN - 15000.00 JN	SB-54/0.5-AV	75.00 UJN - 75.00 UJN
4,4'-DDT	ug/kg	7 / 7	190.00 - 280000.00 D	SB-19-0-0.5	-- - --
SEVIN	ug/kg	2 / 7	227.50 - 4212.50	SB-66/0.5-AV	33.00 UU - 250.00 U
MALATHION	ug/kg	2 / 7	18.25 - 19.00 P	SB-18-0-0.5	17.00 UU - 25.00 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	2 / 6	7770.00 - 11200.00	SB-18-0-0.5	53.00 U - 53.00 U
ARSENIC	mg/kg	7 / 7	3.95 - 15.25	SB-69/0.5-AV	-- - --
BARIUM	mg/kg	2 / 6	60.00 - 63.10	SB-18-0-0.5	35.00 U - 35.00 U
CALCIUM	mg/kg	2 / 6	313.00 B - 1310.00	SB-18-0-0.5	79.00 U - 79.00 U
CHROMIUM	mg/kg	7 / 7	9.10 - 22.30	SB-18-0-0.5	-- - --
CHROMIUM (HEXAVALENT)	mg/kg	3 / 7	0.80 J - 3.10 J	SB-51/0-0.5	1.00 UJ - 1.80 UJ
COBALT	mg/kg	2 / 6	2.50 B - 3.60 B	SB-18-0-0.5	2.00 U - 2.00 U
IRON	mg/kg	2 / 6	12700.00 - 15500.00	SB-18-0-0.5	10.00 U - 10.00 U
LEAD	mg/kg	7 / 7	28.90 J - 88.10	SB-18-0-0.5	-- - --
MAGNESIUM	mg/kg	2 / 6	858.00 B - 1070.00 B	SB-18-0-0.5	20.00 U - 20.00 U
MANGANESE	mg/kg	2 / 6	131.00 - 159.00	SB-18-0-0.5	20.00 U - 20.00 U
MERCURY	mg/kg	2 / 6	0.19 - 1.10	SB-19-0-0.5	0.12 U - 0.12 U
NICKEL	mg/kg	2 / 6	6.50 B - 8.60 B	SB-18-0-0.5	5.00 U - 5.00 U
POTASSIUM	mg/kg	2 / 6	683.00 B - 833.00 B	SB-18-0-0.5	20.00 U - 20.00 U
SELENIUM	mg/kg	1 / 6	1.10 B - 1.10 B	SB-18-0-0.5	0.90 U - 0.90 U
SODIUM	mg/kg	2 / 6	189.00 B - 213.00 B	SB-18-0-0.5	10.00 U - 10.00 U
VANADIUM	mg/kg	2 / 6	22.60 - 29.30	SB-18-0-0.5	5.00 U - 5.00 U
ZINC	mg/kg	2 / 6	32.60 - 69.60	SB-18-0-0.5	5.00 U - 5.00 U

Fungicides		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
SB-18-0-0.5, SB-19-0-0.5, SB-51/0-0.5, SB-54/0.5-AV, SB-64/0.5-AV, SB-66/0.5-AV, SB-69/0.5-AV.

TABLE 2-2 (CONT'D)
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREA B

Dioxin	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
OCTACHLORODIBENZO-P-DIO ug/kg	3 / 3	1.10 J - 11.00	DIOX-1-B	-- - --

SAMPLE GROUP:
DIOX-1-B, DIOX-2-B, DIOX-3-B (Sample locations DIOX-8, DIOX-9, DIOX-10).

TABLE 2-3
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREA C

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
DI-N-BUTYLPHTHALATE	ug/kg	3 / 7	470.00 B - 2205.00	SB-24/0.5-AV	410.00 U - 1500.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
4,4'-DDE	ug/kg	6 / 7	37.00 - 1200.00 CD	SB-01-0-0.5	190.00 UJ - 190.00 UJ
4,4'-DDD	ug/kg	4 / 7	16.00 JN - 500.00 J	SB-31B/0-0.5	4.20 UJN - 36.00 UJN
4,4'-DDT	ug/kg	7 / 7	22.00 B - 3800.00 J	SB-31B/0-0.5	-- - --

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	2 / 6	5850.00 - 7090.00	SB-05-0-0.5	53.00 U - 53.00 U
ARSENIC	mg/kg	7 / 7	5.10 - 22.70	SB-05-0-0.5	-- - --
BARIUM	mg/kg	1 / 6	36.50 B - 36.50 B	SB-02-0-0.5	31.70 UB - 35.00 U
BERYLLIUM	mg/kg	1 / 6	0.34 B - 0.34 B	SB-05-0-0.5	0.23 U - 0.23 U
CALCIUM	mg/kg	2 / 6	431.00 B - 466.00 B	SB-02-0-0.5	79.00 U - 79.00 U
CHROMIUM	mg/kg	7 / 7	10.90 - 16.90	SB-05-0-0.5	-- - --
CHROMIUM (HEXAVALENT)	mg/kg	1 / 7	1.40 J - 1.40 J	SB-21/0.5	1.00 U - 1.00 U
COBALT	mg/kg	2 / 6	3.40 B - 4.50 B	SB-05-0-0.5	2.00 U - 2.00 U
IRON	mg/kg	2 / 6	10100.00 - 16200.00	SB-05-0-0.5	10.00 U - 10.00 U
LEAD	mg/kg	6 / 7	16.90 - 59.00	SS-01	27.18 U - 27.18 U
MAGNESIUM	mg/kg	2 / 6	651.00 B - 829.00 B	SB-05-0-0.5	20.00 U - 20.00 U
MANGANESE	mg/kg	2 / 6	246.00 - 285.00	SB-02-0-0.5	20.00 U - 20.00 U
NICKEL	mg/kg	2 / 6	6.70 B - 8.30 B	SB-05-0-0.5	5.00 U - 5.00 U
POTASSIUM	mg/kg	2 / 6	530.00 B - 816.00 B	SB-05-0-0.5	20.00 U - 20.00 U
SELENIUM	mg/kg	1 / 6	0.99 B - 0.99 B	SB-05-0-0.5	0.90 U - 0.90 U
SODIUM	mg/kg	2 / 6	153.00 B - 209.00 B	SB-05-0-0.5	10.00 U - 10.00 U
VANADIUM	mg/kg	2 / 6	19.80 - 46.40	SB-05-0-0.5	5.00 U - 5.00 U
ZINC	mg/kg	2 / 6	33.90 - 51.30	SB-05-0-0.5	5.00 U - 5.00 U

Fungicides		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
SB-01-0-0.5, SB-02-0-0.5, SB-05-0-0.5, SB-21/0.5, SB-24/0.5-AV, SB-31B/0-0.5, SS-01.

TABLE 2-3 (CONT'D)
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREA C

Dioxin	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
OCTACHLORODIBENZO-P-DIO ug/kg	3 / 3	12.00 - 14.00	DIOX-3-C	-- - --

SAMPLE GROUP:
DIOX-1-C, DIOX-2-C, DIOX-3-C (Sample locations DIOX-1, DIOX-2, DIOX-3).

TABLE 2-4
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREAS A AND C (COMBINED)

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
PHENOL	ug/kg	3 / 21	410.00 - 36000.00	SB-36/0.5-AV	121.50 UJ - 7800.00 U
HEXACHLOROBENZENE	ug/kg	2 / 21	310.00 J - 200000.00 D	SB-07-0-0.5	40.50 UJ - 9100.00 U
DI-N-BUTYLPHTHALATE	ug/kg	4 / 21	312.50 B - 2205.00	SB-24/0.5-AV	380.00 U - 7800.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
LINDANE, TOTAL	ug/kg	1 / 21	33000.00 J - 33000.00 J	SB-07-0-0.5	2.20 U - 20000.00 U
ALDRIN	ug/kg	1 / 21	69000.00 J - 69000.00 J	SB-07-0-0.5	2.20 U - 20000.00 U
ENDOSULFAN I	ug/kg	1 / 21	43.75 - 43.75	SB-40/0.5-AV	2.20 U - 80000.00 U
DIELDRIN	ug/kg	6 / 20	750.00 J - 2200000.00	SB-07-0-0.5	4.30 U - 7700.00 UD
4,4'-DDE	ug/kg	17 / 21	37.00 - 24000.00 J	SB-10-0-0.5	190.00 UJ - 42000.00 UJN
ENDRIN, TOTAL	ug/kg	1 / 21	355.00 X - 355.00 X	SB-40/0.5-AV	4.30 U - 40000.00 U
4,4'-DDD	ug/kg	15 / 21	16.00 JN - 360000.00 JN	SB-07-0-0.5	4.20 UJN - 7300.00 UJ
4,4'-DDT	ug/kg	21 / 21	22.00 B - 6800000.00 D	SB-07-0-0.5	-- - --
METHOXYCHLOR	ug/kg	1 / 21	4900.00 X - 4900.00 X	SB-40/0.5-AV	20.00 U - 800000.00 U
ENDRIN KETONE	ug/kg	1 / 21	80000.00 J - 80000.00 J	SB-07-0-0.5	4.30 U - 40000.00 U
SEVIN	ug/kg	5 / 21	41.00 - 510.00	SB-13-0-0.5	33.00 UU - 250.00 U
MALATHION	ug/kg	3 / 21	23.00 P - 260.00 P	SB-10-0-0.5	17.00 UU - 170.00 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	11 / 18	2345.00 - 12300.00	SB-09-0-0.5	53.00 U - 53.00 U
ARSENIC	mg/kg	22 / 22	2.20 - 132.00	SB-07-0-0.5	-- - --
BARIUM	mg/kg	9 / 18	36.50 B - 79.00	SB-13-0-0.5	28.60 UB - 35.00 U
BERYLLIUM	mg/kg	3 / 18	0.34 B - 1.80	SB-10-0-0.5	0.23 U - 0.23 U
CADMIUM	mg/kg	4 / 22	1.60 - 6.30	SB-35/0-0.5	0.20 U - 0.91 U
CALCIUM	mg/kg	11 / 18	79.80 B - 9600.00	SB-09-0-0.5	79.00 U - 79.00 U
CHROMIUM	mg/kg	22 / 22	5.30 - 96.50	SB-35/0-0.5	-- - --
CHROMIUM (HEXAVALENT)	mg/kg	3 / 21	1.15 J - 2.20 J	SB-11B(0-0.5)	1.00 UJ - 1.00 UJ
COBALT	mg/kg	7 / 18	2.00 B - 4.90 B	SB-15-0-0.5	0.65 UB - 2.00 U
IRON	mg/kg	11 / 18	9430.00 - 62200.00	SB-10-0-0.5	10.00 U - 10.00 U
LEAD	mg/kg	21 / 22	16.90 - 480.50 J	SB-36/0.5-AV	27.18 U - 27.18 U
MAGNESIUM	mg/kg	11 / 18	197.50 B - 5140.00	SB-09-0-0.5	20.00 U - 20.00 U
MANGANESE	mg/kg	8 / 18	32.60 - 331.00	SB-09-0-0.5	12.30 U - 20.00 U
MERCURY	mg/kg	6 / 18	0.13 - 0.94	SB-13-0-0.5	0.12 U - 0.12 U
NICKEL	mg/kg	9 / 18	5.00 B - 9.80	SB-13-0-0.5	2.60 UB - 5.00 U
POTASSIUM	mg/kg	11 / 18	442.00 B - 1070.00 B	SB-15-0-0.5	20.00 U - 20.00 U
SELENIUM	mg/kg	5 / 18	0.72 B - 15.20	SB-13-0-0.5	0.90 U - 0.90 U
SODIUM	mg/kg	11 / 18	153.00 B - 375.00 B	SB-09-0-0.5	10.00 U - 10.00 U
THALLIUM	mg/kg	3 / 18	0.95 B - 2.30	SB-10-0-0.5	1.00 U - 1.00 U
VANADIUM	mg/kg	11 / 18	10.10 B - 46.40	SB-05-0-0.5	5.00 U - 5.00 U
ZINC	mg/kg	11 / 18	8.85 - 88.50	SB-09-0-0.5	5.00 U - 5.00 U

TABLE 2-4 (CONT'D)
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE SOIL
AREAS A AND C (COMBINED)

Fungicides	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
SB-06-0-0.5-AV, SB-07-0-0.5, SB-08-0-0.5, SB-09-0-0.5, SB-10-0-0.5, SB-11-0-0.5-AV, SB-11B(0-0.5), SB-12
SB-13-0-0.5, SB-14-0-0.5, SB-15-0-0.5, SB-35/0-0.5, SB-36/0.5-AV, SB-40/0.5-AV, SB-46/0.5-AV, SB-01-0-0.5
SB-02-0-0.5, SB-05-0-0.5, SB-21/0.5, SB-24/0.5-AV, SB-31B/0-0.5, SS-01.

Dioxin	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
OCTACHLORODIBENZO-P-DIO ug/kg	7 / 7	2.70 J - 14.00	DIOX-3-C	-- - --

SAMPLE GROUP:
DIOX-1-A, DIOX-2-A, DIOX-3-A, DIOX-4-A, DIOX-1-C, DIOX-2-C, DIOX-3-C (Sample locations DIOX-1, DIOX-2, DIOX-3, DIOX-4, DIOX-5, DIOX-6, DIOX-7).

TABLE 2-5
PULVERIZING SERVICE SITE
SUMMARY OF CHEMICALS IN SUBSURFACE SOIL
AREA A

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
METHYLENE CHLORIDE	ug/kg	5 / 15	9.00 - 110.00	B6/S3A 5-8	3.00 UJ - 12.00 U
ACETONE	ug/kg	7 / 15	10.50 B - 95.00	B19/S3A 4-7	4.00 UJB - 18.00 UU
TOLUENE	ug/kg	1 / 15	7.00 - 7.00	B6/S3A 5-8	3.50 UJ - 12.00 U

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
PHENOL	ug/kg	2 / 15	410.00 - 810.00	B11/S3A 4-7	26.00 UJ - 4250.00 U
DI-N-BUTYLPHTHALATE	ug/kg	1 / 15	4200.00 B - 4200.00 B	SB-10/1.0	370.00 U - 4650.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/kg	17 / 46	12.00 - 14700.00	B6/S3A 5-8	2.00 U - 5155.00 U
BETA-BHC	ug/kg	4 / 46	20.00 - 2300.00	B6/S3A 5-8	2.00 U - 5950.00 U
DELTA-BHC	ug/kg	8 / 46	10.00 - 290.00 J	SB-09/1-2	2.00 UJ - 5950.00 U
LINDANE, TOTAL	ug/kg	12 / 46	9.00 - 6000.00	B6/S3A 5-8	0.88 UJ - 5080.00 U
ALDRIN	ug/kg	2 / 46	22.00 - 6900.00	B6/S3A 5-8	0.18 UJN - 5055.00 U
ENDOSULFAN I	ug/kg	3 / 46	17.00 - 230.00	B7/S3-A 5-7	2.00 U - 21000.00 UJ
DIELDRIN	ug/kg	8 / 46	22.00 - 63900.00	B6/S3A 5-8	0.25 UJ - 21000.00 UJ
4,4'-DDE	ug/kg	6 / 46	35.00 - 8200.00	B12/S3 5-7	0.44 UJ - 1850.00 UJ
4,4'-DDD	ug/kg	12 / 46	27.00 CJN - 22000.00	B6/S3A 5-8	3.90 UJN - 1000.00 UJ
4,4'-DDT	ug/kg	29 / 46	30.00 - 442000.00	B6/S3A 5-8	9.80 U - 148.00 U
SEVIN	ug/kg	19 / 46	100.00 - 230000.00	SB-14/1-AV	33.00 UU - 250.00 U
MALATHION	ug/kg	1 / 46	70.00 - 70.00	B7/S3-A 5-7	17.00 U - 70.00 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	8 / 13	2570.00 - 10900.00	B7/S3-A 5-7	53.00 U - 53.00 U
ARSENIC	mg/kg	9 / 14	3.10 - 24.80	SB-15/1-2	2.00 U - 6.00 U
BARIUM	mg/kg	7 / 13	30.00 - 70.00	B7/S3-A 5-7	20.00 U - 35.00 U
BERYLLIUM	mg/kg	2 / 13	0.70 - 1.00	B11/S3A 4-7	0.23 U - 0.60 U
CALCIUM	mg/kg	8 / 13	30.00 - 610.00	B11/S3A 4-7	79.00 U - 79.00 U
CHROMIUM	mg/kg	16 / 16	4.00 - 47.00	B7/S3-A 5-7	-- - --
COBALT	mg/kg	1 / 13	7.00 - 7.00	B2A/S1 5-6.5	1.50 UB - 6.00 U
COPPER	mg/kg	6 / 7	3.00 - 23.00	B7/S3-A 5-7	2.00 U - 2.00 U
IRON	mg/kg	8 / 13	3450.00 - 17600.00	B11/S3A 4-7	10.00 U - 10.00 U
LEAD	mg/kg	16 / 16	2.40 - 124.00 J	SB-15/1-2	-- - --
MAGNESIUM	mg/kg	8 / 13	70.00 - 840.00	B11/S3A 4-7	20.00 U - 20.00 U
MANGANESE	mg/kg	8 / 13	6.00 - 184.00	B1/S3A 4-7	20.00 U - 20.00 U
MERCURY	mg/kg	1 / 13	0.12 - 0.12	SB-12/0.5-1.5	0.04 U - 0.12 U
NICKEL	mg/kg	4 / 13	5.00 - 11.00	B11/S3A 4-7	4.00 U - 5.00 U
POTASSIUM	mg/kg	8 / 13	130.00 - 1420.00	B11/S3A 4-7	20.00 U - 20.00 U
SELENIUM	mg/kg	1 / 13	0.90 B - 0.90 B	SB-12/0.5-1.5	0.60 U - 0.90 U
SODIUM	mg/kg	2 / 13	80.00 - 168.00 B	SB-12/0.5-1.5	10.00 U - 60.00 U
VANADIUM	mg/kg	7 / 13	9.00 - 41.00	B11/S3A 4-7	5.00 U - 5.00 U
ZINC	mg/kg	8 / 13	6.00 - 90.00	B8/S3A 5-7	5.00 U - 5.00 U

TABLE 2-5 (CONT'D)
PULVERIZING SERVICE SITE
SUMMARY OF CHEMICALS IN SUBSURFACE SOIL
AREA A

Fungicides	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
B1/S3A 4-7, B1/S6 10-12, B-2/S-5 10-12, B2A/S1 5-6.5, B-3/S3 5-7, B-3/S5 10-12, B4/S3 5-7, B4/S5 10-12
B5/S-4 7.5-9.5, B5/S-5 10-12, B6/S3A 5-8, B6/S6A 10-12, B7/S3-A 5-7, B7/S5-A 10-12, B8/S3A 5-7, B8/S5 10-12
B9/S3 5-7, B9/S5 10-12, B10/S3 5-7, B10S5 10-12, B11/S3A 4-7, B11/S6 10-12, B12/S3 5-7, B12/S5 10-12
B13/S3 5-7, B13/S5 10-12, B14/S3 5-7, B14/S5 10-12, B15/S3 5-7, B15/S5 10-12, B16/S3A 5-7, B16/S5 10-12
B17/S3A 5-7, B17/S5 10-12, B18/S3 5-7, B18/S5 10-13, B19/S3A 4-7, B19/S6 10-12, SB-09/1-2, SB-10/1.0
SB-12/0.5-1.5, SB-12/1.5-2.5, SB-14/1-AV, SB-15/1-2, SB-34/1-2, SB-37/1.0, SB-71/3-4.

TABLE 2-6
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SUBSURFACE SOIL
AREA B

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ACETONE	ug/kg	1 / 3	46.00 - 46.00	B20/S3A 4-7	12.00 U - 12.00 U

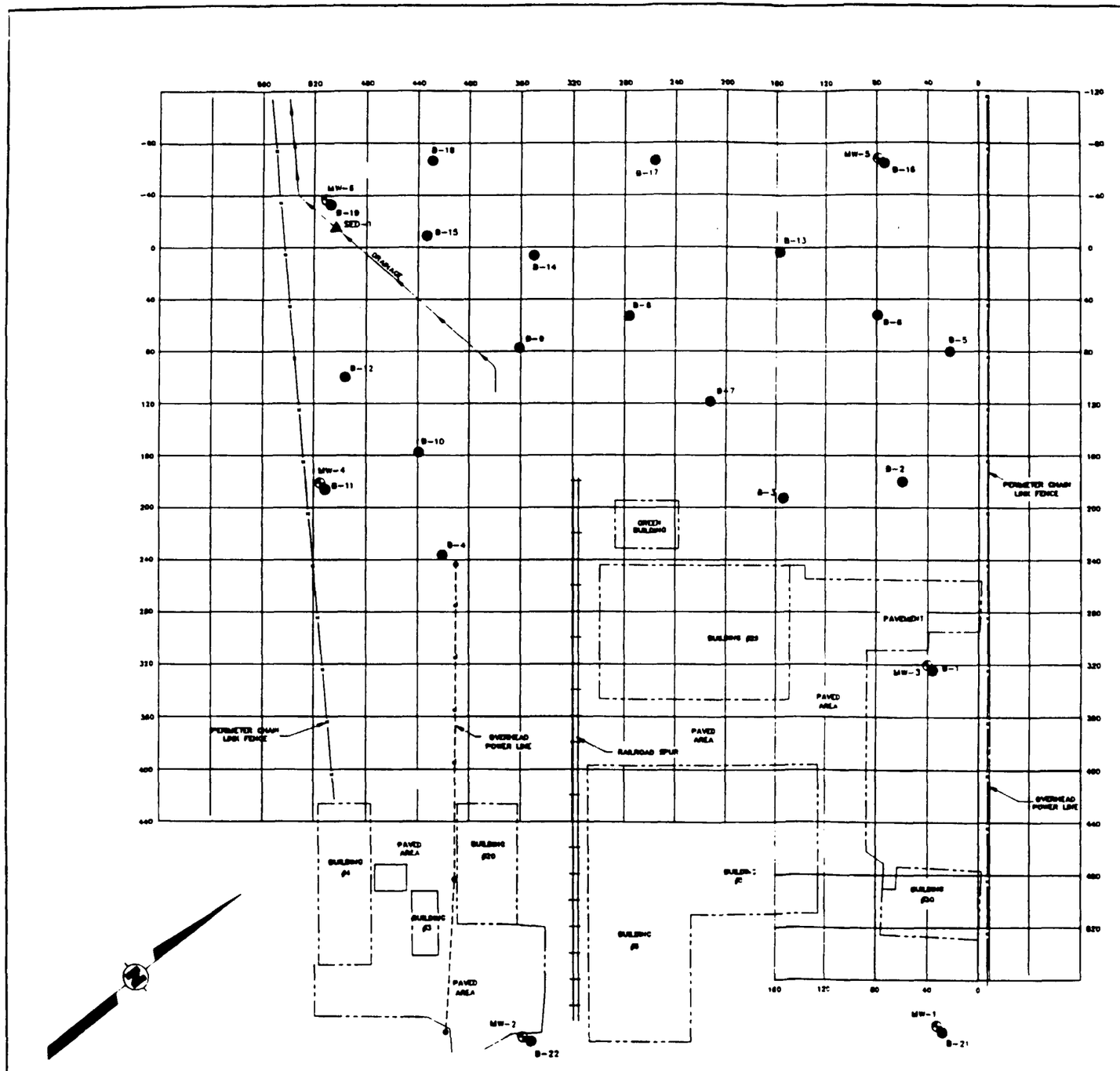
SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
BUTYLBENZYLPHTHALATE	ug/kg	1 / 2	1000.00 J - 1000.00 J	SB-60/1.0	360.00 U - 360.00 U
BIS (2-ETHYLHEXYL) PHTH	ug/kg	1 / 2	1400.00 J - 1400.00 J	SB-60/1.0	360.00 U - 360.00 U

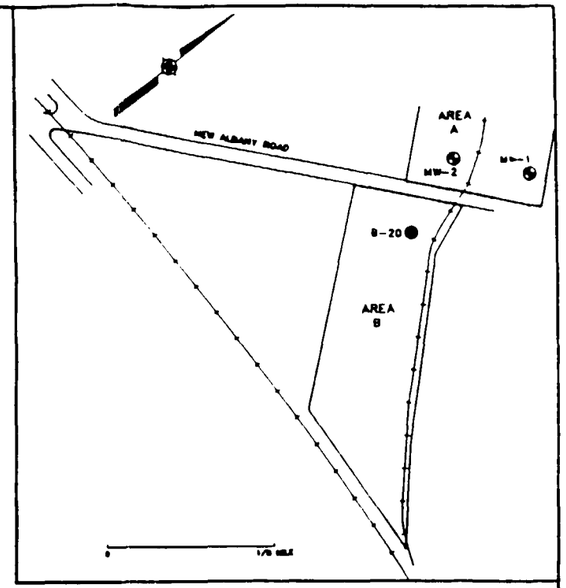
Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/kg	1 / 7	12.00 - 12.00	B20/S3A 4-7	20.00 U - 200000.00 U
BETA-BHC	ug/kg	2 / 7	24.00 - 180.00	SS-1 0.75-1	20.00 U - 200000.00 U
4,4'-DDE	ug/kg	2 / 7	720.00 - 226000.00	SS-4A 0.75-1	15.00 UJC - 300000.00 U
4,4'-DDD	ug/kg	3 / 7	31.00 - 1940.00	SS-3A 0.75-1	280.00 U - 56000.00 U
4,4'-DDT	ug/kg	6 / 7	196.00 - 1240000.00	SS-4A 0.75-1	680.00 DU - 680.00 DU

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	1 / 2	10800.00 - 10800.00	B20/S3A 4-7	53.00 U - 53.00 U
ARSENIC	mg/kg	1 / 2	3.60 - 3.60	SB-60/1.0	6.00 U - 6.00 U
BERYLLIUM	mg/kg	1 / 2	0.80 - 0.80	B20/S3A 4-7	0.23 U - 0.23 U
CALCIUM	mg/kg	1 / 2	20.00 - 20.00	B20/S3A 4-7	79.00 U - 79.00 U
CHROMIUM	mg/kg	2 / 2	14.10 - 17.00	B20/S3A 4-7	-- - --
COPPER	mg/kg	1 / 1	25.00 - 25.00	B20/S3A 4-7	-- - --
IRON	mg/kg	1 / 2	21100.00 - 21100.00	B20/S3A 4-7	10.00 U - 10.00 U
LEAD	mg/kg	2 / 2	4.50 - 5.60 J	SB-60/1.0	-- - --
MAGNESIUM	mg/kg	1 / 2	370.00 - 370.00	B20/S3A 4-7	20.00 U - 20.00 U
MANGANESE	mg/kg	1 / 2	63.00 - 63.00	B20/S3A 4-7	20.00 U - 20.00 U
MERCURY	mg/kg	1 / 2	0.08 - 0.08	B20/S3A 4-7	0.12 U - 0.12 U
NICKEL	mg/kg	1 / 2	6.00 - 6.00	B20/S3A 4-7	5.00 U - 5.00 U
POTASSIUM	mg/kg	1 / 2	350.00 - 350.00	B20/S3A 4-7	20.00 U - 20.00 U
VANADIUM	mg/kg	1 / 2	26.00 - 26.00	B20/S3A 4-7	5.00 U - 5.00 U
ZINC	mg/kg	1 / 2	14.00 - 14.00	B20/S3A 4-7	5.00 U - 5.00 U

Fungicides	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
B20/S3A 4-7, B20/S6 10-12, SB-60/1.0, SS-1 0.75-1, SS-2 0.75-1, SS-3A 0.75-1, SS-4A 0.75-1.





LEGEND:

- B-3 SOIL BORING
- MW-1 SHALLOW MONITORING WELL
- SED-1 SEDIMENT SAMPLING LOCATION

SCALE
40 0 40 80 FEET

FIGURE 8

Phase I Monitoring Well Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 12, "Location of Borings and Monitoring Wells", Phase I Site Investigation Report, Pulverizing Services Site, New Jersey, Revision 2, Paul C. Rizzo Associates, Inc., August 12, 1993.

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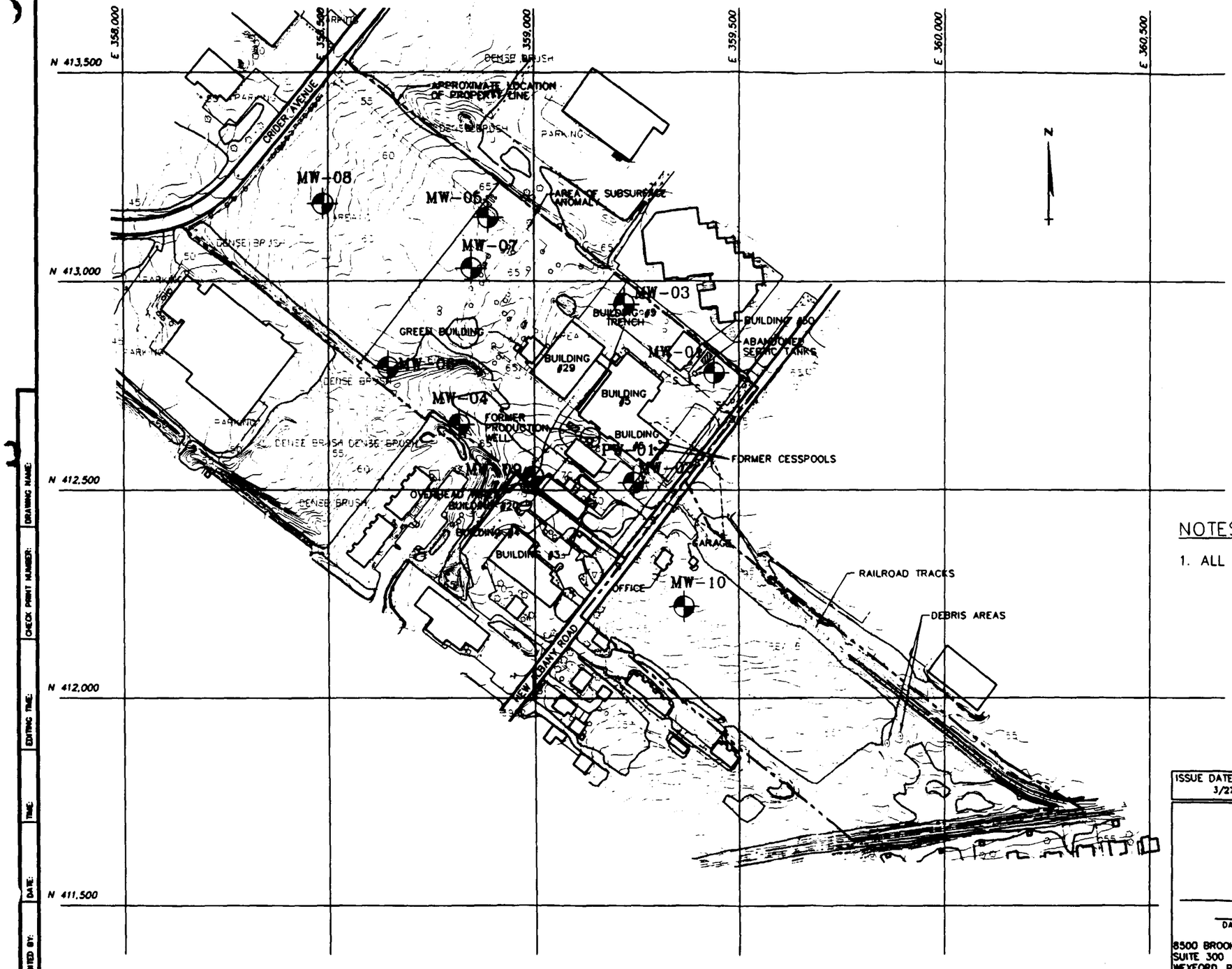
monitoring well locations. These ground water samples were analyzed for TCL organics, Sevin, Malathion, PCNB, and TAL metals and cyanide (filtered and unfiltered samples).

Unfiltered ground water samples have been used in this risk assessment.

As part of the Phase II SI activities, ground water was sampled in February 1995 from ten monitoring wells in the surficial saturated zone, MW-01 through MW-10, and from the production well intersecting the deeper, potable water aquifer. Figure 9 shows the monitoring well and production well sample locations. Ten ground water samples (one from each monitoring well) plus two duplicates and one ground water sample from the production well were collected for analysis by McLaren/Hart. These samples were analyzed for TCL organics, Sevin, Malathion, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, and hexavalent chromium. Additionally, one sample of petroleum product found in the production well was sampled by McLaren/Hart and analyzed for TCL pesticides and total recoverable petroleum hydrocarbons. The single production well sample has only been qualitatively addressed in this report. The results of the petroleum product sample indicate that the product was motor oil. This result has not been further evaluated in this report. Although CDM Federal accepted three split ground water samples, these results have not been included in this risk assessment.

Only the most recent (Phase II) ground water sample results from the monitoring wells have been used in this risk assessment. At the request of the USEPA, a brief comparison of results was made between 1990 monitoring well sample data and 1995 monitoring well sample data. No



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE
- MW-04 GROUNDWATER SAMPLE LOCATIONS

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

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FIGURE 9

Phase II Monitoring Well
and Production Well Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 9, "Groundwater Sample Locations", Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, March 27, 1995.

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trends in chemical concentration were observed.

The ground water sample grouping evaluated in this risk assessment is presented in Table 2-7.

2.1.4 Surface Water

As part of the Phase II SI activities, seven surface water locations were sampled by McLaren/Hart. Figure 10 shows the surface water sampling locations. Seven surface water plus two duplicate samples were collected from the following locations: two from the drainage ditch in Area A, two from the drainage ditch in Area B, two from the swampy area of Area B, and one from the drainage ditch in Area C. These samples were analyzed for TCL organics, Sevin, Malathion, rotenone, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, hexavalent chromium, and TOX. Although CDM Federal accepted one split surface water sample, these results have not been included in the risk assessment per direction from the USEPA.

Surface water results have been grouped according to the drainage system they are associated with. The surface water sample groupings evaluated in this risk assessment are presented in Tables 2-8 and 2-9.

2.1.5 Sediment

As part of the Phase I SI activities, one sediment sample was collected by Rizzo Associates. This

TABLE 2-7
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN GROUND WATER
(SITE-WIDE, SATURATED SURFICIAL AQUIFER)

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ACETONE	ug/l	5 / 10	68.00 J - 1200.00 J	MW-03	10.00 U - 24.00 UJ
CHLOROFORM	ug/l	1 / 10	14.50 - 14.50	MW-10-AV	3.00 UJ - 80.00 U
CARBON TETRACHLORIDE	ug/l	1 / 10	7.25 - 7.25	MW-10-AV	10.00 U - 80.00 U
BENZENE	ug/l	1 / 10	15.00 - 15.00	MW-07	3.00 UJ - 80.00 U
TETRACHLOROETHENE	ug/l	3 / 10	11.00 - 140.00	MW-09	6.00 U - 80.00 U
CHLOROBENZENE	ug/l	1 / 10	49.00 - 49.00	MW-07	2.00 UJ - 80.00 U
ETHYLBENZENE	ug/l	2 / 10	10.00 J - 11.00	MW-07	10.00 U - 80.00 U
XYLENES (TOTAL)	ug/l	2 / 10	11.00 - 89.50	MW-05-AV	10.00 U - 80.00 U

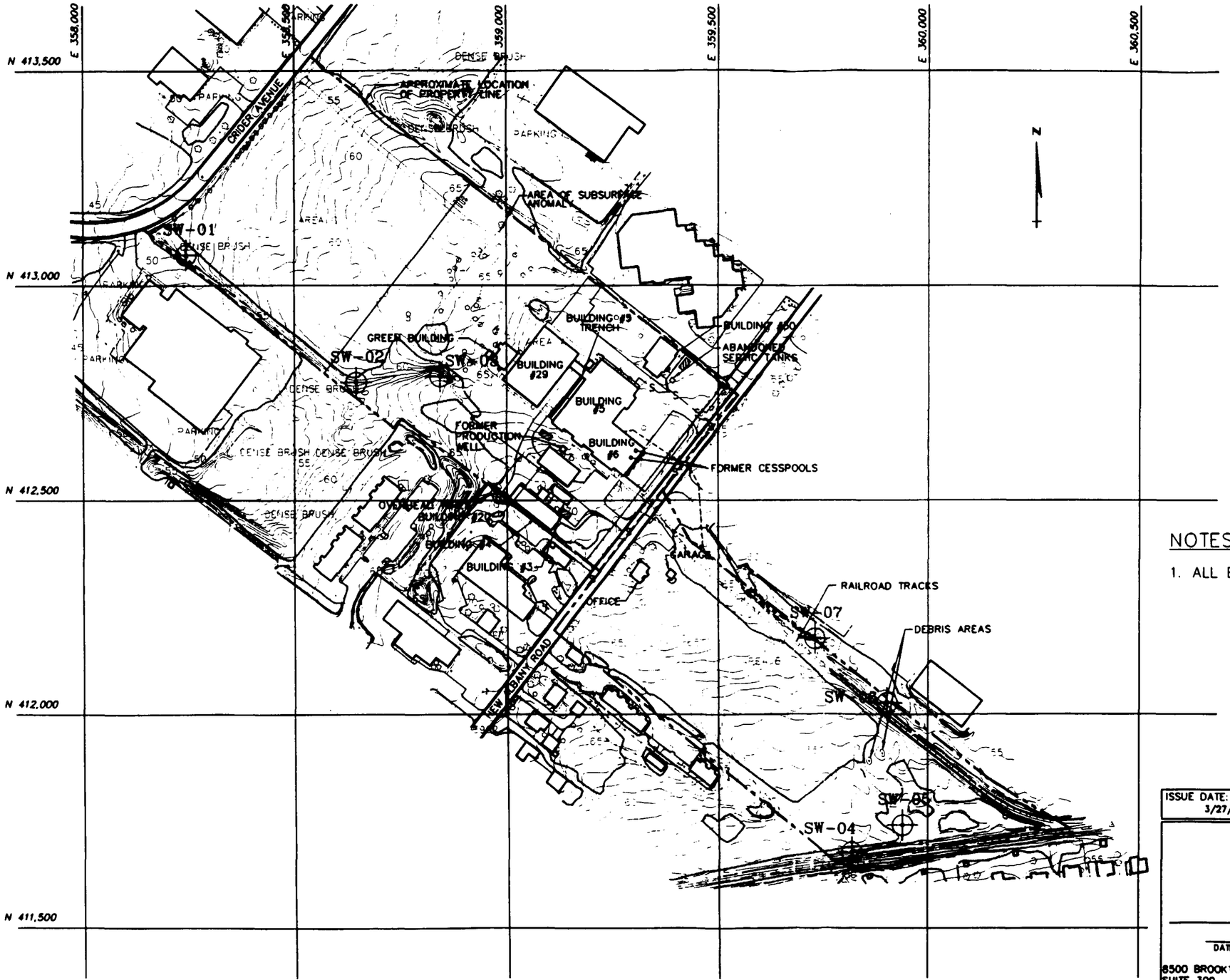
SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
4-METHYLPHENOL	ug/l	1 / 10	10.00 - 10.00	MW-07	10.00 U - 70.00 U
NAPHTHALENE	ug/l	1 / 10	170.00 - 170.00	MW-02	1.00 UJ - 10.00 U
2-METHYLNAPHTHALENE	ug/l	1 / 10	390.00 - 390.00	MW-02	1.00 UJ - 10.00 U
DIETHYLPHTHALATE	ug/l	2 / 10	10.00 - 14.50	MW-05-AV	10.00 U - 70.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/l	8 / 9	0.26 JN - 69.00 DJ	MW-07	0.01 UJ - 0.01 UJ
BETA-BHC	ug/l	6 / 8	0.05 JN - 6.00 JN	MW-07	0.05 U - 0.05 U
DELTA-BHC	ug/l	5 / 9	0.08 JN - 20.00 DJ	MW-07	0.02 U - 0.09 UJ
LINDANE, TOTAL	ug/l	8 / 10	0.07 - 33.50 D	MW-05-AV	0.05 U - 0.05 U
DIELDRIN	ug/l	2 / 10	0.21 - 1.35 J	MW-05-AV	0.01 UJ - 2.00 U
ENDRIN, TOTAL	ug/l	1 / 10	0.15 - 0.15	MW-04	0.02 UJ - 2.00 U
4,4'-DDD	ug/l	2 / 9	0.10 JP - 0.20 JN	MW-02	0.10 U - 5.00 UJD
4,4'-DDT	ug/l	2 / 10	0.10 - 0.11 JN	MW-01	0.02 UJ - 2.00 U
ENDRIN KETONE	ug/l	1 / 10	1.30 - 1.30	MW-05-AV	0.10 U - 2.00 U
GAMMA-CHLORDANE	ug/l	1 / 10	0.05 J - 0.05 J	MW-02	0.05 U - 1.00 U
SEVIN	ug/l	4 / 10	95.00 - 1400.00	MW-05-AV	10.00 U - 10.00 U
MALATHION	ug/l	3 / 10	1.00 - 5.50	MW-09	0.50 U - 0.50 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ARSENIC	ug/l	6 / 10	6.80 B - 771.00	MW-02	10.00 U - 100.00 U
CADMIUM	ug/l	4 / 10	7.30 - 54.55 J	MW-10-AV	5.00 U - 5.00 U
CHROMIUM	ug/l	7 / 10	9.00 B - 444.00	MW-02	8.00 U - 8.00 U
CHROMIUM (HEXAVALENT)	ug/l	1 / 3	20.00 - 20.00	MW-08	20.00 U - 20.00 U
LEAD	ug/l	9 / 10	2.20 BJ - 160.00 J	MW-02	40.00 U - 40.00 U

Fungicides		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
MW-01, MW-02, MW-03, MW-04, MW-05-AV, MW-06, MW-07, MW-08
MW-09, MW-10-AV.



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE
- SW-07 SURFACE WATER SAMPLE LOCATIONS

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

0 250 500 750 FEET

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8500 BROCKTREE ROAD
SUITE 300
WEXFORD, PA. 15090

FIGURE 10

Surface Water Sample Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 8, "Surface Water Sample Locations", Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, March 27, 1995.

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TABLE 2-8
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE WATER
DRAINAGE FROM AREA A THROUGH AREA C

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ACETONE	ug/l	1 / 3	16.00 - 16.00	SW-02	8.00 UJ - 9.00 U
XYLENES (TOTAL)	ug/l	1 / 3	92.00 - 92.00	SW-03	10.00 U - 10.00 U

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/l	3 / 3	8.25 J - 25.00	SW-02	-- - --
BETA-BHC	ug/l	3 / 3	0.80 JN - 3.20 J	SW-03	-- - --
DELTA-BHC	ug/l	3 / 3	2.30 J - 9.40	SW-02	-- - --
LINDANE, TOTAL	ug/l	3 / 3	6.70 D - 18.00	SW-02	-- - --
DIELDRIN	ug/l	2 / 3	0.42 - 3.50	SW-03	0.90 UJ - 0.90 UJ
4,4'-DDE	ug/l	1 / 3	1.90 - 1.90	SW-03	0.62 UJ - 1.00 U
4,4'-DDD	ug/l	2 / 3	1.48 JN - 8.40 DJ	SW-03	0.40 UJ - 0.40 UJ
4,4'-DDT	ug/l	2 / 3	2.39 JD - 29.00 D	SW-03	0.41 UJ - 0.41 UJ
METHOXYCHLOR	ug/l	2 / 3	2.58 - 26.00	SW-03	1.20 UJ - 1.20 UJ
SEVIN	ug/l	2 / 3	57.00 - 64.00	SW-03	20.00 U - 20.00 U
MALATHION	ug/l	1 / 3	0.67 - 0.67	SW-03	0.50 U - 0.50 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ARSENIC	ug/l	3 / 3	1.55 B - 4.00 B	SW-02	-- - --
CADMIUM	ug/l	3 / 3	23.60 - 34.90	SW-02	-- - --
CHROMIUM	ug/l	3 / 3	3.85 - 9.40 B	SW-03	-- - --
LEAD	ug/l	3 / 3	2.35 B - 8.10	SW-03	-- - --

Fungicides		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
SW-01-AV, SW-02, SW-03.

TABLE 2-9
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SURFACE WATER
DRAINAGE FROM AREA A THROUGH AREA B

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
FLUORANTHENE	ug/l	1 / 4	13.00 - 13.00	SW-05	10.00 U - 10.00 U
PYRENE	ug/l	1 / 4	12.00 - 12.00	SW-05	10.00 U - 10.00 U
BIS (2-ETHYLHEXYL) PHTH	ug/l	1 / 4	16.00 - 16.00	SW-04-AV	8.00 UJ - 10.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/l	3 / 4	0.51 J - 3.80 D	SW-07	0.95 UJ - 0.95 UJ
BETA-BHC	ug/l	3 / 4	0.23 - 0.77	SW-07	0.56 UJ - 0.56 UJ
DELTA-BHC	ug/l	2 / 4	0.05 - 0.31 J	SW-07	0.10 UJ - 0.27 UJ
LINDANE, TOTAL	ug/l	2 / 4	0.25 - 0.53	SW-07	0.20 UJ - 0.38 UJ
DIELDRIN	ug/l	2 / 4	0.08 J - 1.00 J	SW-07	0.35 UJ - 0.71 UJ
4,4'-DDE	ug/l	1 / 4	4.60 J - 4.60 J	SW-05	0.01 UJ - 0.50 U
4,4'-DDD	ug/l	3 / 4	0.08 - 50.00 D	SW-05	0.13 UJN - 0.13 UJN
4,4'-DDT	ug/l	1 / 4	11.00 D - 11.00 D	SW-05	0.07 UJ - 0.57 UJN
ENDRIN KETONE	ug/l	1 / 4	0.15 JN - 0.15 JN	SW-07	0.06 UUJN - 0.28 UJN
SEVIN	ug/l	1 / 4	23.00 - 23.00	SW-07	20.00 U - 40.00 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ARSENIC	ug/l	4 / 4	2.80 B - 616.00	SW-05	-- - --
CADMIUM	ug/l	2 / 4	10.30 B - 65.20	SW-05	3.00 U - 3.00 U
CHROMIUM	ug/l	2 / 4	5.35 - 518.00	SW-05	5.00 U - 5.00 U
LEAD	ug/l	4 / 4	2.20 B - 3220.00	SW-05	-- - --

Fungicides		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

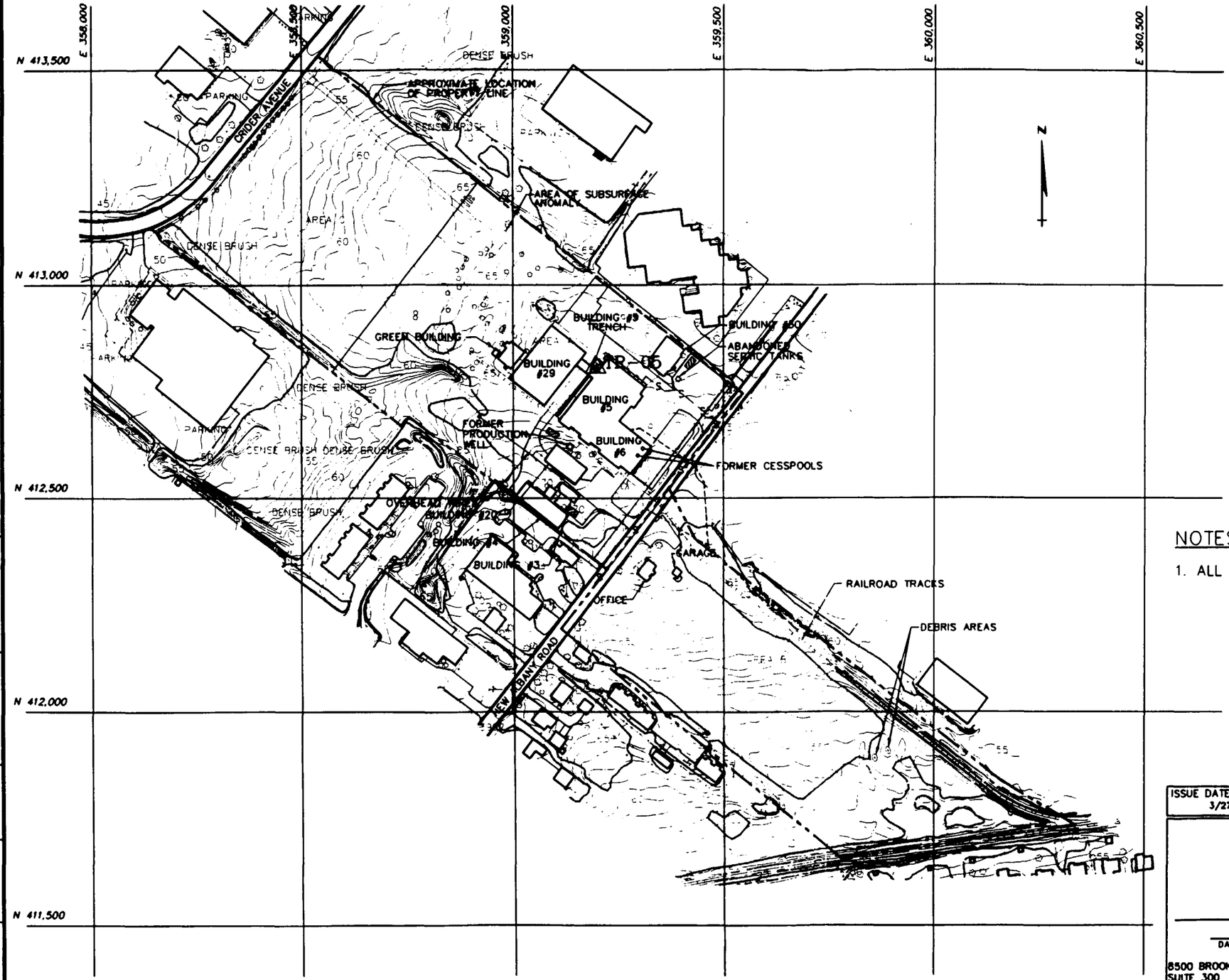
SAMPLE GROUP:
SW-04-AV, SW-05, SW-06, SW-07.

sample location (SED-1) can be found on Figure 3. This sediment sample was collected in Area A and was analyzed for TCL organics, Sevin, Malathion, dioxins, PCNB, and TAL metals and cyanide.

As part of the Phase II SI activities, nine sediment locations were sampled by McLaren/Hart from the Building 5 trench, a storm sewer, drainage ditches, and a swampy area in Area B. These samples are described below.

One sediment sample, TRENCH 5, was collected from the trench that runs along the outside of Building 5. Figure 11 shows this sample location. This sample was analyzed for TCL organics, Sevin, Malathion, rotenone, dioxins, PCNB, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, hexavalent chromium, and TOX. This sample has been grouped with the Area A through Area B drainage ditch samples as it is ultimately connected with this drainage system.

One sediment sample, STORM-1, was collected from a storm sewer inlet at New Albany Road and Area A. Figure 12 identifies this sample location. This sample was analyzed for TCL organics, Sevin, Malathion, dioxins, selected metals (arsenic, cadmium, chromium, and lead) by EPA method 6010, hexavalent chromium, and TOX. This sample has been grouped with Area A through Area B drainage ditch samples as it appears to be interconnected with this drainage system.



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE
- TR-05 / A — BUILDING 5 TRENCH SAMPLE LOCATION

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

0 250 500 750 FEET

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FIGURE 11

Building 5 Trench Sample Location

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 5, "Building 5 Trench Sample Location", Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation. March 27, 1995.

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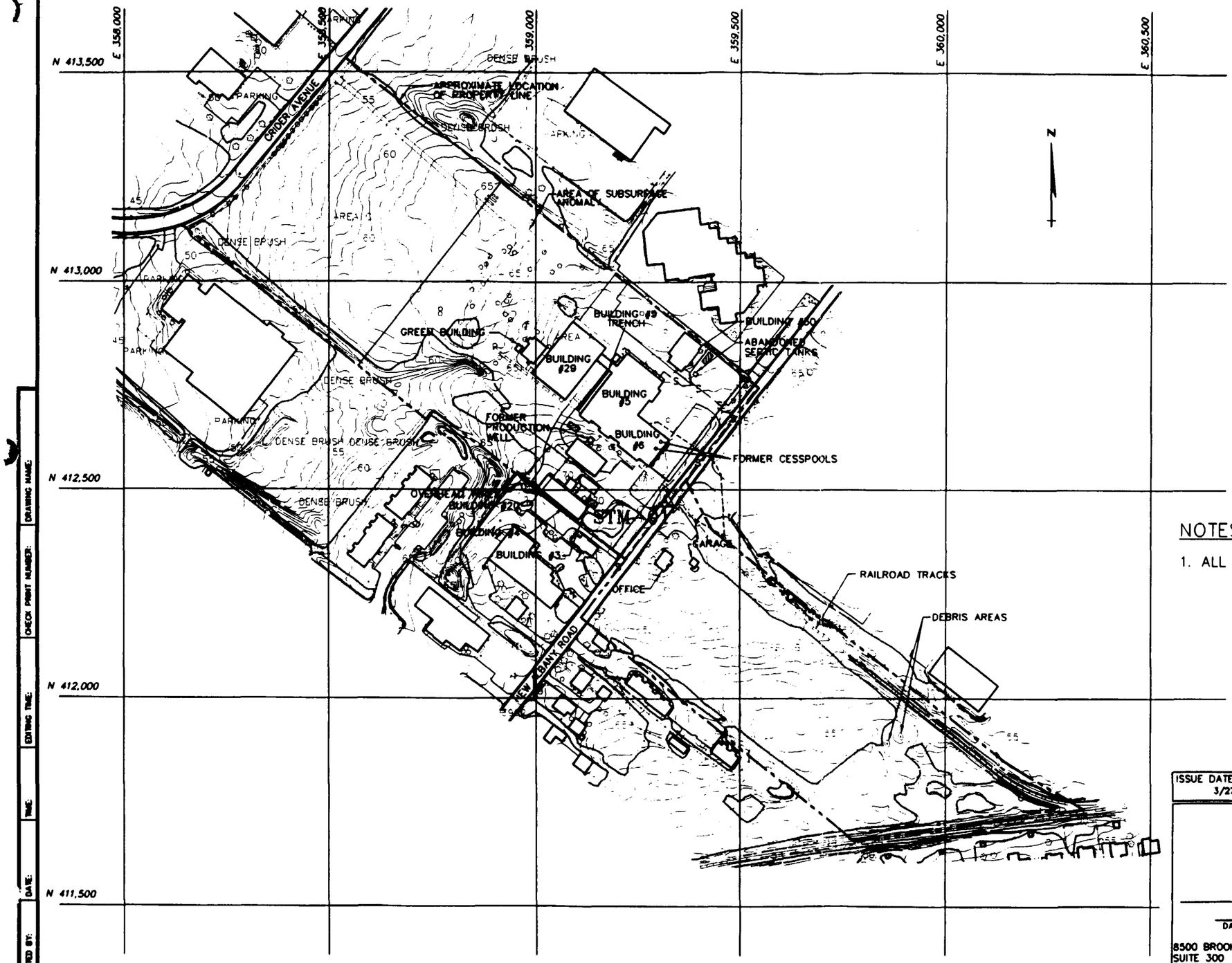

LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE

STM-01
A STORM SEWER SAMPLE LOCATION

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

0 250 500 750 FEET

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SUITE 300
WEXFORD, PA. 15090

FIGURE 12

Storm Sewer Sample Location

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 6, "Storm Sewer Sample Locations", Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, March 27, 1995.

700071

Seven sediment (SED-1 through SED-7) and two duplicate samples were collected from the following locations: two from the drainage ditch in Area A, two from the drainage ditch in Area B, two from the swampy area in Area B, and one from the drainage ditch in Area C. Figure 13 identifies these sample locations. These sediment samples were analyzed for TCL organics, Sevin, Malathion, rotenone, selected metals (arsenic, cadmium, chromium, and lead) by USEPA method 6010, hexavalent chromium, and TOX. Although CDM Federal accepted one split sediment sample, these data are not included in the risk assessment.

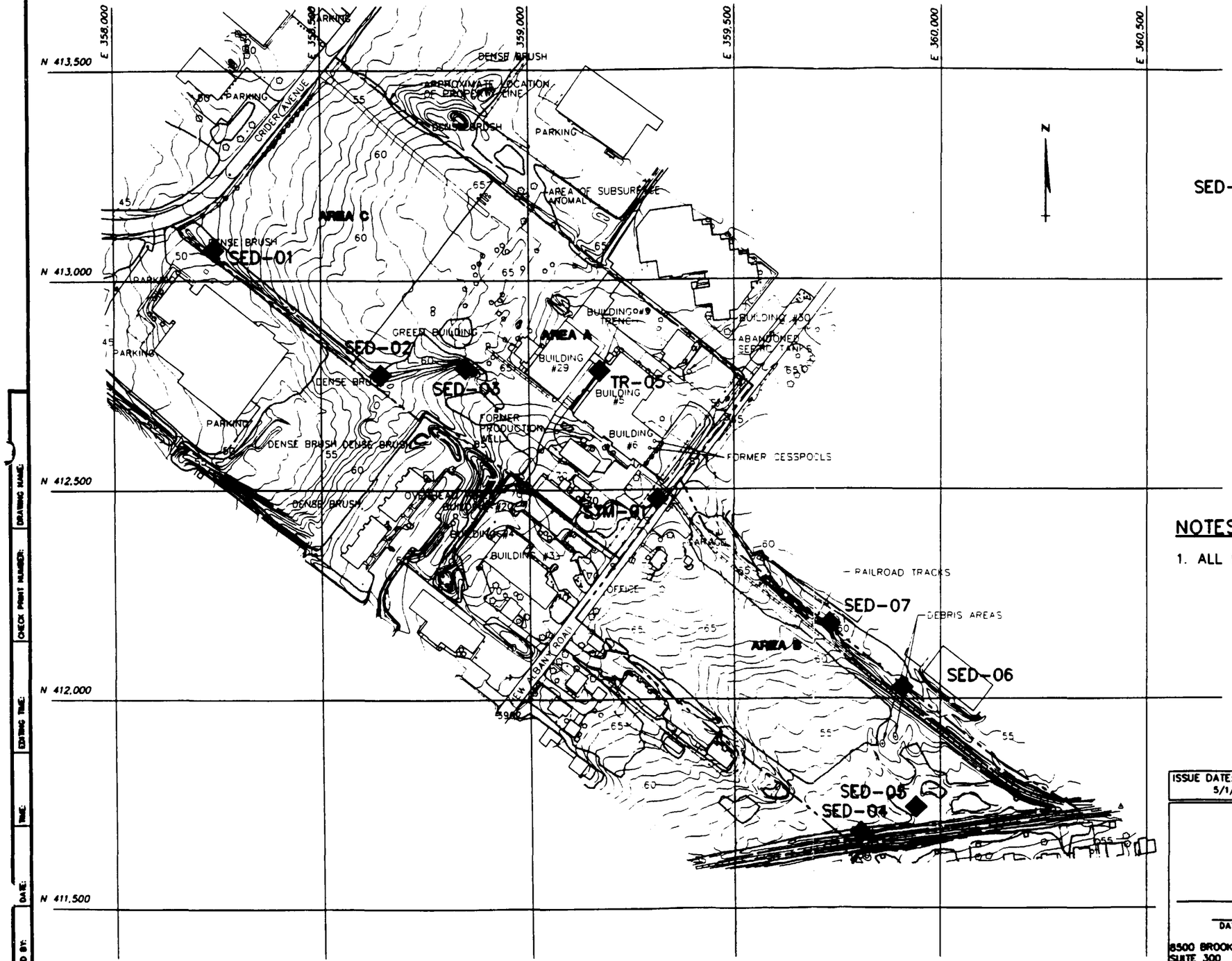
The sediment samples were additionally field screened for total chlorinated compounds and metals (arsenic, cadmium, chromium, and lead). These data have not been included in the human health risk assessment since laboratory results which meet a more rigorous data quality objective are available for all of these samples.

Sediment results have been grouped according to the drainage system they are associated with. The sediment sample groupings evaluated in this risk assessment are presented in Tables 2-10 and 2-11.

2.2 Summary of Sampling and Analysis Results

2.2.1 Data Quality

As part of the data evaluation process, the quality of all site soil, ground water, surface water,



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE
- SED-06 ◆ SEDIMENT SAMPLE LOCATION

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

0 250 500 750 FEET

DRAWING NAME: | CHECK PRINT NUMBER: | EDITING TIME: | TIME: | DATE: | EDITED BY:

ISSUE DATE: 5/1/95

DATE

8500 BROOKTREE ROAD
SUITE 300
WEXFORD, PA. 15090

FIGURE 13

Sediment Sample Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 6, "Sediment Sampling Locations", Phase II Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, May 1, 1995.

700073

TABLE 2-10
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SEDIMENT
DRAINAGE FROM AREA A THROUGH AREA C

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
METHYLENE CHLORIDE	ug/kg	1 / 4	93.00 - 93.00	SED-1	12.00 U - 17.00 U
ACETONE	ug/kg	1 / 4	48.00 B - 48.00 B	SED-02	10.00 U - 20.00 UJ
BENZENE	ug/kg	1 / 4	10.00 - 10.00	SED-1	12.00 U - 17.00 U
TETRACHLOROETHENE	ug/kg	1 / 4	10.00 - 10.00	SED-1	5.00 UJ - 17.00 U
CHLOROBENZENE	ug/kg	1 / 4	32.00 - 32.00	SED-1	6.00 UJ - 17.00 U
ETHYLBENZENE	ug/kg	1 / 4	10.00 - 10.00	SED-1	12.00 U - 17.00 U
XYLENES (TOTAL)	ug/kg	1 / 4	98.00 - 98.00	SED-1	9.00 UJ - 17.00 U

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
PHENOL	ug/kg	2 / 4	1170.00 - 2500.00	SED-02	210.00 UJ - 1200.00 U
4-CHLOROANILINE	ug/kg	1 / 4	4575.00 - 4575.00	SED-01-AV	100.00 UJ - 600.00 U
BIS (2-ETHYLHEXYL) PHTH	ug/kg	1 / 4	420.00 - 420.00	SED-03	250.00 UJ - 600.00 U

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/kg	2 / 4	450.00 J - 550.00	SED-03	2000.00 U - 2800.00 U
BETA-BHC	ug/kg	1 / 4	350.00 - 350.00	SED-01-AV	280.00 UJ - 2800.00 U
DELTA-BHC	ug/kg	1 / 4	380.00 - 380.00	SED-01-AV	260.00 UJ - 2800.00 U
LINDANE, TOTAL	ug/kg	1 / 4	320.00 J - 320.00 J	SED-01-AV	310.00 UJ - 2800.00 U
DIELDRIN	ug/kg	1 / 4	620.00 - 620.00	SED-01-AV	4200.00 U - 7900.00 UD
4,4'-DDE	ug/kg	2 / 4	830.00 P - 2627.50	SED-01-AV	470.00 UJP - 4200.00 U
4,4'-DDD	ug/kg	4 / 4	3500.00 JN - 31000.00	SED-02	-- - --
4,4'-DDT	ug/kg	3 / 4	16000.00 D - 120000.00 D	SED-02	4200.00 U - 4200.00 U
METHOXYCHLOR	ug/kg	2 / 4	24500.00 - 45000.00	SED-03	20000.00 U - 28000.00 U
SEVIN	ug/kg	2 / 4	307.50 - 540.00	SED-02	250.00 U - 2000.00 U
MALATHION	ug/kg	3 / 4	150.00 - 440.00	SED-03	33.00 U - 33.00 U

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALUMINUM	mg/kg	1 / 1	5870.00 - 5870.00	SED-1	-- - --
ARSENIC	mg/kg	3 / 4	6.20 - 11.40	SED-01-AV	5.00 U - 5.00 U
CADMIUM	mg/kg	1 / 4	4.30 - 4.30	SED-1	0.72 U - 1.00 U
CALCIUM	mg/kg	1 / 1	310.00 - 310.00	SED-1	-- - --
CHROMIUM	mg/kg	4 / 4	8.00 - 19.90	SED-01-AV	-- - --
COPPER	mg/kg	1 / 1	54.00 - 54.00	SED-1	-- - --
IRON	mg/kg	1 / 1	15100.00 - 15100.00	SED-1	-- - --
LEAD	mg/kg	4 / 4	22.90 - 52.10	SED-02	-- - --
MAGNESIUM	mg/kg	1 / 1	280.00 - 280.00	SED-1	-- - --
MANGANESE	mg/kg	1 / 1	60.00 - 60.00	SED-1	-- - --
MERCURY	mg/kg	1 / 1	0.21 - 0.21	SED-1	-- - --
NICKEL	mg/kg	1 / 1	7.00 - 7.00	SED-1	-- - --
POTASSIUM	mg/kg	1 / 1	230.00 - 230.00	SED-1	-- - --
SELENIUM	mg/kg	1 / 1	4.30 - 4.30	SED-1	-- - --
VANADIUM	mg/kg	1 / 1	9.00 - 9.00	SED-1	-- - --
ZINC	mg/kg	1 / 1	304.00 - 304.00	SED-1	-- - --
CYANIDE	mg/kg	1 / 1	0.20 - 0.20	SED-1	-- - --

TABLE 2-10 (CONT'D)
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SEDIMENT
DRAINAGE FROM AREA A THROUGH AREA C

Fungicides	Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SAMPLE GROUP:
SED-1, SED-02, SED-03, SED-01-AV.

06/22/1995
11:23 AM

TABLE 2-11
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SEDIMENT
DRAINAGE FROM AREA A THROUGH AREA B

VOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units

SVOCs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ACENAPHTHENE	ug/kg	1 / 6	1500.00 J - 1500.00 J	TRENCH 5	25.00 UJ - 2200.00 U
FLUORENE	ug/kg	1 / 6	1800.00 J - 1800.00 J	TRENCH 5	28.00 UJ - 680.00 UJ
N-NITROSODIPHENYLAMINE	ug/kg	1 / 6	2900.00 J - 2900.00 J	TRENCH 5	440.00 U - 2200.00 U
PHENANTHRENE	ug/kg	1 / 6	27000.00 - 27000.00	TRENCH 5	160.00 UJ - 1100.00 UJ
ANTHRACENE	ug/kg	1 / 6	9000.00 J - 9000.00 J	TRENCH 5	41.00 UJ - 680.00 UJ
FLUORANTHENE	ug/kg	2 / 6	590.00 - 45000.00	TRENCH 5	41.00 UJ - 1600.00 UJ
PYRENE	ug/kg	2 / 6	460.00 J - 33000.00	TRENCH 5	39.00 UJ - 1100.00 UJ
BENZO (A) ANTHRACENE	ug/kg	1 / 6	22000.00 - 22000.00	TRENCH 5	160.00 UJ - 820.00 UJ
CHRYSENE	ug/kg	1 / 6	20000.00 - 20000.00	TRENCH 5	160.00 UJ - 810.00 UJ
BENZO(B)FLUORANTHENE	ug/kg	2 / 6	440.00 J - 24000.00	TRENCH 5	238.50 UJ - 870.00 UJ
BENZO(K) FLUORANTHENE	ug/kg	1 / 6	12000.00 J - 12000.00 J	TRENCH 5	120.00 UJ - 680.00 UJ
BENZO (A) PYRENE	ug/kg	1 / 6	18000.00 J - 18000.00 J	TRENCH 5	150.00 UJ - 600.00 UJ

Pesticides/PCBs		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ALPHA-BHC	ug/kg	2 / 6	39.00 - 750.00	SED-07	2.40 UJ - 300.00 U
BETA-BHC	ug/kg	2 / 6	28.00 J - 210.00 J	SED-07	1.95 UJN - 300.00 U
ENDOSULFAN I	ug/kg	1 / 5	31.00 - 31.00	SED-06	8.30 U - 300.00 U
DIELDRIN	ug/kg	5 / 6	11.75 - 3200.00 X	SED-07	670.00 U - 670.00 U
4,4'-DDE	ug/kg	6 / 6	15.23 J - 1000.00 JN	TRENCH 5	-- - --
4,4'-DDD	ug/kg	6 / 6	630.00 - 6700.00 D	SED-07	-- - --
4,4'-DDT	ug/kg	6 / 6	190.00 - 40000.00 D	TRENCH 5	-- - --
METHOXYCHLOR	ug/kg	1 / 6	28000.00 D - 28000.00 D	TRENCH 5	14.00 UJ - 1100.00 U
SEVIN	ug/kg	4 / 6	440.00 - 9600.00	STORM-1	250.00 U - 250.00 U
MALATHION	ug/kg	1 / 6	170.00 - 170.00	TRENCH 5	25.00 U - 33.00 U
ROTENONE	ug/kg	1 / 1	30000.00 J - 30000.00 J	TRENCH 5	-- - --

Inorganic Analytes		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
ARSENIC	mg/kg	6 / 6	2.60 - 27.40 J	SED-05	-- - --
CADMIUM	mg/kg	3 / 6	2.50 J - 56.70	TRENCH 5	0.80 U - 0.94 U
CHROMIUM	mg/kg	6 / 6	8.60 - 90.20	TRENCH 5	-- - --
LEAD	mg/kg	6 / 6	17.95 - 1020.00 J	TRENCH 5	-- - --

Fungicides		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units	Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units
PCNB	ug/kg	1 / 6	48000.00 - 48000.00	TRENCH 5	440.00 U - 2200.00 U

SAMPLE GROUP:
TRENCH 5, STORM-1, SED-04-AV, SED-05, SED-06, SED-07.

TABLE 2-11 (CONT'D)
PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS IN SEDIMENT
DRAINAGE FROM AREA A THROUGH AREA B

11:23 AM

Dioxin		Freq of/ # of Detects/Samples	Detected Samples Minimum, units - Maximum, units			Sample with High Concentration	Nondetected Samples Minimum, units - Maximum, units		
1,2,3,4,7,8,9-HpCDF	ug/kg	1 / 1	8.70	-	8.70	TRENCH 5	--	-	--
OCTACHLORODIBENZO-P-DIO	ug/kg	1 / 1	0.12	-	0.12	TRENCH 5	--	-	--

SAMPLE GROUP:
TRENCH 5.

sediment, and air sample data was evaluated. As previously stated, all non-field screening SI data were validated in accordance with USEPA Region II data validation protocols. However, it should be noted that the data for certain samples and analytes that were not rejected during validation were qualified for the following reasons:

- The "J" qualifier indicates for all chemicals that the reported concentration is estimated.
- The "B" qualifier indicates for organics that the reported concentration is estimated since it was detected in both the sample and in the associated blank; for inorganics, the "B" qualifier indicates that the reported value is less than the contract required detection limit but greater than the instrument detection limit.
- The "N" qualifier for organics indicates that there is only presumptive evidence for their presence; for inorganics, the N qualifier indicates that the spiked sample recovery is not within control limits.
- The "D" qualifier for organics indicates that the chemical was identified in an analysis at a secondary dilution factor.
- The "P"qualifier for pesticides indicates a greater than 25 percent difference for detected concentrations between two GC columns.
- The "U" qualifier for all chemicals indicates that the chemical was not detected at the reported detection limit.
- The "C" qualifier for pesticides indicates that the reported value was confirmed by gas chromatography/mass spectrometry.
- Per McLaren/Hart, the "X" qualifier for organics indicates that the reported value required multiple qualifiers and to see the case narrative. The case narratives did not contain further clarification for this qualifier.

In general, data with qualifiers that indicate uncertainties in concentrations but not identity were utilized in this risk assessment. Rejected data, qualified with an "R", were not used in this risk assessment since the chemical's identity and concentration are uncertain. Data qualified with a

"U" were used in this risk assessment, as appropriate, in producing data summary tables and in calculating 95 percent UCLs (see Sections 2.2 and 3.3). Samples having duplicate results were given the suffix - AV so that the samples would be recognized properly as averaged results in the computer data base.

2.2.2 Chemicals Detected in Soil

Surface Soil: Site surface soil sample data are presented in Tables 2-1 through 2-4 for Areas A, B, C, and A and C (Combined). The future-use scenario assumes future residential development of Areas A and C at the same time since they are located adjacent to each other. At present, no construction work (i.e., development of the Areas) is in progress.

Area A

The results of the analysis of nineteen surface soil samples and five duplicates collected from a depth of zero to 0.5 feet bgs in Area A are presented in Table 2-1.

No VOCs were detected in the Area A surface soil samples analyzed for VOCs.

Three SVOCs (phenol, hexachlorobenzene, di-n-butylphthalate) were detected in at least one Area A surface soil sample. The most frequently detected SVOC was phenol (3 of 14 samples). The SVOC detected at the highest concentration was hexachlorobenzene (200,000 D μg/kg) in sample

SB-07-0-0.5.

Twelve pesticides were detected in at least one Area A surface soil sample. The most frequently detected pesticides were 4,4'-DDT (14 of 14 samples), 4,4'-DDE (11 of 14 samples), and 4,4'-DDD (11 of 14 samples). The pesticides detected at the highest concentrations were 4,4'-DDT (6,800,000 D μg/kg) and dieldrin (2,200,000 μg/kg) in sample SB-07-0-0.5. Neither PCBs nor the fungicide PCNB was detected in Area A surface soil samples.

Twenty-one inorganics were detected in at least one Area A surface soil sample. Arsenic, chromium, and lead were detected in 15 of 15 samples. Of these three metals, lead was detected at the highest concentration (480.5 J mg/kg) in sample SB-36/0.5-AV. Sample SB-36/0.5-AV is the averaged result of sample SB-36/0.5 and its duplicate.

One dioxin, octachlorodibenzo-p-dioxin (OCDD), was detected in 4 of 4 Area A surface soil samples analyzed for dioxins. The maximum detected concentration was 12 μg/kg in sample DIOX-2-A.

Area B

The results of the analysis of ten surface soil samples and four duplicates collected from a depth of zero to 0.5 feet bgs in Area B are presented in Table 2-2.

No VOCs were detected in the Area B surface soil samples analyzed for VOCs.

Nine SVOCs were detected in at least one Area B surface soil sample. The most frequently detected SVOC was benzo(b)fluoranthene (2 of 7 samples). All other SVOCs were detected in a single sample. The SVOC detected at the highest concentration was benzo(b)fluoranthene (4,850 µg/kg) in sample SB-66/0.5-AV. Sample SB-66/0.5-AV is the averaged result of sample SB-66/0.5 and its duplicate. It should be noted that all maximum SVOC concentrations were reported in this sample.

Seven pesticides were detected in at least one Area B surface soil sample. The most frequently detected pesticides were 4,4'-DDE (7 of 7 samples) and 4,4'-DDT (7 of 7 samples). The pesticide detected at the highest concentration was 4,4'-DDT (280,000 D µg/kg) in sample SB-19-0-0.5. Neither PCBs nor the fungicide PCNB was detected in Area B surface soil samples.

Eighteen inorganics were detected in at least one Area B surface soil sample. Arsenic, chromium, and lead were detected in 7 of 7 samples. Of the inorganic chemicals of potential concern (see Table 2-24), arsenic and manganese were detected at maximum concentrations of 15.25 mg/kg and 159 mg/kg in samples SB-69/0.5-AV and SB-18-0-0.5, respectively. Sample SB-69/0.5-AV is the averaged result of SB-69/0.5 and is duplicate.

One dioxin, OCDD, was detected in 3 of 3 Area B surface soil samples analyzed for dioxins. The maximum detected concentration was 11 µg/kg in sample DIOX-1-B.

Area C

The results of the analysis of ten surface soil samples and one duplicate collected from a depth of zero to 0.5 feet bgs in Area C are presented in Table 2-3.

No VOCs were detected in the Area C surface soil samples analyzed for VOCs.

One SVOC, di-n-butylphthalate, was detected in 3 of 7 Area C surface soil samples. The maximum concentration, 2,205 μg/kg, was reported in sample SB-24/0.5-AV. Sample SB-24/0.5-AV is the averaged result of sample SB-24/0.5 and its duplicate.

Three pesticides (4,4'-DDE, 4,4'-DDD, and 4,4'-DDT) were detected in Area C surface soil samples. The most frequently detected pesticide was 4,4'-DDT (7 of 7 samples). The pesticide detected at the highest concentration was also 4,4'-DDT (3,800 J μg/kg) in sample SB-31B/0-0.5. Neither PCBs nor the fungicide PCNB was detected in Area C surface soil samples.

Eighteen inorganics were detected in at least one Area C surface soil sample. Arsenic and chromium were the most frequently detected inorganic analytes (7 of 7 samples). Of the inorganic chemicals of potential concern (see Table 2-24), manganese was reported at the highest concentration (285 mg/kg) in sample SB-02-0-0.5.

One dioxin, OCDD, was detected in 3 of the 3 Area C surface soil samples analyzed for dioxins.

The maximum detected concentration was 14 ug/kg in sample DIOX-3-C.

Areas A and C (Combined)

The results of twenty-nine surface soil samples and six duplicates collected in both Areas A and C (Combined) are presented in Table 2-4.

No VOCs were detected in surface soil samples from Areas A and C (Combined).

Three SVOCs, phenol, hexachlorobenzene, and di-n-butylphthalate, were detected in surface soil samples from Areas A and C (Combined). The most frequently detected SVOC was di-n-butylphthalate (4 of 21 samples). The SVOC detected at the highest concentration was hexachlorobenzene (200,000 D ug/kg) in sample SB-07-0-0.5.

Twelve pesticides were detected in surface soil samples from Areas A and C (Combined). The most frequently detected pesticide was 4,4'-DDT (21 of 21 samples). The pesticides detected at the highest concentration were 4,4'-DDT (6,800,000 D ug/kg) and dieldrin (2,200,000 ug/kg) in sample SB-07-0-0.5. Neither PCBs nor the fungicide PCNB was detected in surface soil from Areas A and C (Combined).

Twenty-one inorganics were detected in surface soil samples from Areas A and C (Combined). Arsenic and chromium were the most frequently detected inorganics (22 of 22 samples). The

highest reported concentration of arsenic was 132 mg/kg in sample SB-07-0-0.5. The highest reported concentration of chromium was 96.5 mg/kg in sample SB-35/0-0.5.

One dioxin, OCDD, was detected in 7 of 7 surface soil samples from Areas A and C (Combined). The highest detected concentration of this dioxin was 14 μg/kg in sample DIOX-3-C.

Subsurface Soil: Subsurface soil sample data are presented in Tables 2-5 and 2-6 for Areas A and B. At present, no construction work (i.e., development of the Areas) is in progress.

Area A

The results of the analysis of 47 subsurface soil samples and one duplicate collected in Area A from a depth range varying from one to thirteen feet bgs are presented in Table 2-5.

Three VOCs (methylene chloride, acetone, and toluene) were detected in at least one subsurface soil sample from Area A. The most frequently detected VOC was acetone (7 of 15 samples). The VOCs detected at the highest concentrations were methylene chloride (110 μg/kg) in sample B6/S3A 5-8 and acetone (95 μg/kg) in sample B19/S3A 4-7.

Two SVOCs (phenol and di-n-butylphthalate) were detected in at least one subsurface soil sample from Area A. Phenol was detected in 2 of 15 samples at a maximum of 810 μg/kg in sample B11/S3A 4-7. Di-n-butylphthalate was detected in 1 of 15 samples at 4,200 B μg/kg in sample

SB-10/1.0.

Twelve pesticides were detected in at least one subsurface soil sample from Area A. The most frequently detected pesticides were 4,4'-DDT (29 of 46 samples) and Sevin (19 of 46 samples). The pesticides detected at the highest concentrations were 4,4'-DDT (442,000 μg/kg) in sample B6/S3A 5-8 and Sevin (230,000 μg/kg) in sample SB-14/1-AV. Sample SB-14/1-AV is the averaged result of the sample SB-14/1 and its duplicate. Neither PCBs nor the fungicide PCNB was detected in Area A subsurface soil.

Nineteen inorganics were detected in at least one Area A subsurface soil sample. Lead and chromium were detected 16 of 16 samples. Of the inorganic chemicals of potential concern (see Table 2-24), arsenic and manganese were detected at maximum concentrations of 24.8 mg/kg and 184 mg/kg in samples SB15/1-2 and B1/S3A 4-7, respectively.

Area B

The results of the analysis of seven subsurface soil samples collected from a depth range varying from 0.75 to 12 feet bgs are presented in Table 2-6.

One VOC, acetone, was detected in 1 of 3 Area B subsurface soil samples at a concentration of 46 μg/kg. This concentration was reported in sample B20/S3A 4-7.

Two SVOCs, butylbenzylphthalate and bis(2-ethylhexyl)phthalate, were detected in 1 of 2 Area B subsurface soil samples. The highest concentration was reported for bis(2-ethylhexyl)phthalate (1400 J μg/kg) in sample SB-60/1.0.

Five pesticides were detected in at least one subsurface soil sample collected in Area B. The most frequently detected pesticide was 4,4'-DDT (6 of 7 samples). The pesticides detected at the highest concentrations were 4,4'-DDT (1,240,000 μg/kg) and 4,4'-DDE (226,000 μg/kg) in sample SS-4A 0.75-1. Neither PCBs nor the fungicide PCNB was detected in Area B subsurface soil samples.

Fifteen inorganics were detected in at least 1 of the 2 subsurface soil samples analyzed for inorganic analytes. Chromium and lead were each detected in 2 of 2 samples. Of the inorganic chemicals of potential concern, arsenic (see Table 2-24), was detected at a maximum concentration of 3.6 mg/kg in samples SB-60/1.0.

2.2.3 Chemicals Detected in Air

The results of the analysis of the single onsite air sample, AS-01, are presented in Appendix E. The only detection in this samples occurred for the pesticide alpha-BHC which was detected at a concentration of 160 μg/kg.

2.2.4 Chemicals Detected in Ground Water

The results of the analysis of the single deep aquifer ground water sample from the onsite production well, PW-01, are presented in Appendix E. In this ground water sample, none of the chemicals analyzed for (i.e., SVOCs, pesticides, PCBs, arsenic, cadmium, chromium, and lead) were detected.

A single site-wide data summary for the saturated surficial ground water aquifer is presented in Table 2-7. Ground water samples collected from onsite monitoring wells during the Phase II sampling activities have been included. Samples having duplicate results, as for the soils, were given the suffix -AV so that the samples would be recognized properly as averaged results in the computer data base.

The results of the analysis of 10 ground water samples and two duplicates collected on site are presented in Table 2-7.

Eight VOCs, including chlorinated aliphatic and aromatic compounds, were detected in at least one sample. The most frequently detected VOCs were acetone (5 of 10 samples) and tetrachloroethene (3 of 10 samples). The VOCs detected at the highest concentrations were also acetone (1,200 J µg/l) and tetrachloroethene (140 µg/l), in samples MW-03 and MW-09, respectively.

Four SVOCs, 4-methylphenol, naphthalene, 2-methylnaphthalene, and diethylphthalate, were detected in at least one sample. The most frequently detected SVOC was diethylphthalate (2 of 10 samples). The SVOCs detected at the highest concentrations were 2-methylnaphthalene (390 μg/l) and naphthalene (170 μg/l) in sample MW-02.

Twelve pesticides were detected in at least one site ground water sample. The most frequently detected pesticides were alpha-BHC (8 of 9 samples) and gamma-BHC (lindane, total) (8 of 10 samples). The highest pesticide concentrations were reported for Sevin (1,400 μg/l) in sample MW-05-AV and alpha-BHC (69 DJ μg/l) in sample MW-07. Sample MW-05-AV is the averaged result of sample MW-05 and its duplicate. Neither PCBs nor the fungicide PCNB was detected in ground water samples.

Five metals (arsenic, cadmium, chromium, hexavalent chromium, and lead) were detected in at least one sample. The most frequently detected metals were lead (9 of 10 samples) and chromium (7 of 10 samples). The inorganic chemicals of potential concern, arsenic and cadmium (See Table 2-4), were detected at maximum concentrations of 771 μg/l and 54.6 J μg/l in samples MW-02 and MW-10-AV, respectively. Sample MW-10-AV is the averaged result of sample MW-10 and its duplicate.

2.2.5 Chemicals Detected in Surface Water

The data summaries for surface water are presented in Tables 2-8 and 2-9 for Drainage from Area

A through Area C and Drainage from Area A through Area B, respectively.

Drainage from Area A through Area C

The results of the analysis of three surface water samples and one duplicate collected from the drainage ditch from Area A through Area C are presented in Table 2-8.

Two VOCs (acetone and xylenes (total)) were each detected 1 of 3 surface water samples from drainage from Area A through Area C. The VOC detected at the highest concentration was xylenes (total) (92 μg/l) in sample SW-03.

No SVOCs were detected in any surface water sample from drainage from Area A through Area C.

Eleven pesticides were detected in at least one surface water sample from drainage from Area A through Area C. The most frequently detected pesticides were alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC (lindane, total) in 3 of 3 samples. The pesticides detected at the highest concentrations were Sevin (64 μg/l) and 4,4'-DDT (29 D μg/l) in sample SW-03. Neither PCBs nor the fungicide PCNB was detected in surface water samples from drainage from Areas A through Area C.

Four metals were detected in 3 of 3 surface water samples from drainage from Area A through

Area C. The inorganic chemicals of potential concern, arsenic and cadmium (See Table 2-24), were detected at maximum concentrations of 4.0 B μg/l and 34.9 μg/l in sample SW-02.

Drainage from Area A through Area B

The results of the analysis of four surface water samples and one duplicate collected from the drainage ditch from Area A through Area B are presented in Table 2-9.

No VOCs were detected in the surface water from drainage from Area A through Area B.

Three SVOCs (fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate) were detected in at least one surface water sample. Each of the SVOCs was detected 1 of 4 samples. The SVOC bis(2-ethylhexyl)phthalate was detected at the highest concentration (16 μg/l) in sample SW-04-AV. Sample SW-04-AV is the averaged result of the sample SW-04 and its duplicate.

Ten pesticides were detected in at least one surface water sample in drainage from Area A through Area B. The most frequently detected pesticides were alpha-BHC, beta-BHC, and 4,4'-DDD in 3 of 4 samples. The highest pesticide concentrations were reported for 4,4'-DDD (50 D μg/l) in sample SW-05 and Sevin (23 μg/l) in sample SW-07. Neither PCBs nor the fungicide PCNB was detected in the surface water samples from drainage from Area A through Area B.

Four metals (arsenic, cadmium, chromium, and lead) were detected in at least one surface water

sample from drainage from Area A through Area B. The most frequently detected metals were arsenic and lead in 4 of 4 samples. The inorganic chemicals of potential concern, arsenic, trivalent chromium, and hexavalent chromium (see Table 2-24). Maximum detected concentrations were 616 μg/l for arsenic, and 444 μg/l for trivalent chromium and 74 μg/l for hexavalent chromium (based on a total chromium value of 518 μg/l) in sample SW-05.

2.2.6 Chemicals Detected in Sediment

The data summaries for sediment are presented in Tables 2-10 and 2-11 for Drainage from Area A through Area C and Drainage from Area A through Area B.

Drainage from Area A through Area C

The results of the analysis of three sediment samples and one duplicate collected from the drainage ditch from Area A through Area C are presented in Table 2-10.

Seven VOCs, primarily aromatic compounds, were each detected in 1 of 4 sediment samples from drainage from Area A through Area C. The VOCs detected at the highest concentrations were xylenes (total) (98 μg/kg) and methylene chloride (93 μg/kg) in sample SED-1.

Three SVOCs (phenol, 4-chloraniline, and bis(2-ethylhexyl)phthalate) were detected in at least one sediment sample from drainage from Area A through Area C. The most frequently detected

SVOC was phenol in 2 of 4 samples. The highest SVOC concentration was reported for 4-chloraniline (4,575 µg/kg) in sample SED-01-AV. Sample SED-01-AV is the averaged results of the sample SED-01 and its duplicate.

Eleven pesticides were detected in at least one sediment sample from drainage from Area A through Area C. The most frequently detected pesticide was 4,4'-DDD in 4 of 4 samples. The pesticides detected at the highest concentration were 4,4'-DDT (120,000 D µg/kg) in sample SED-02 and methoxychlor (45,000 µg/kg) in sample SED-03. Neither PCBs nor the fungicide PCNB was detected in sediment samples from drainage from Area A through Area C.

Seventeen inorganics were detected in at least one sediment sample from drainage from Area A through Area C. However, only 1 of the 4 samples was analyzed for TAL metals and cyanide. The remaining 3 sediment samples were analyzed for the following selected metals: arsenic, cadmium, chromium, hexavalent chromium, and lead. The most frequently detected inorganics were chromium and lead in 4 of 4 samples. Of the inorganic chemicals of potential concern (see Table 2-24), manganese was reported at the highest concentration (60 mg/kg) in sample SED-1.

Drainage from Area A through B

The results of the analysis of six sediment samples and one duplicate collected from the drainage ditch from Area A through Area B are presented in Table 2-11.

No VOCs were detected in the sediment from drainage from Area A through Area B.

Twelve SVOCs, primarily PAHs, were detected in at least one sediment sample from drainage from Area A through Area B. The most frequently detected SVOCs were fluoranthene, pyrene, and benzo(b)fluoranthene in 2 of 6 samples. The SVOCs detected at the highest concentrations were fluoranthene (45,000 μg/kg) and pyrene (33,000 μg/kg) in sample TRENCH 5. It should be noted that all maximum SVOC concentrations were reported in sample TRENCH 5.

Eleven pesticides were detected in at least one sediment sample from drainage from Area A through Area B. The most frequently detected pesticides were 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT in 6 of 6 samples. The highest pesticide concentrations were reported for 4,4'-DDT (40,000 D μg/kg), rotenone (30,000 J μg/kg), and methoxychlor (28,000 D μg/kg) in sample TRENCH 5.

No PCBs were detected in sediment samples from drainage from Area A through Area B. The fungicide PCNB was detected in 1 of 6 samples at a concentration of 48,000 μg/kg in sample TRENCH 5.

Four metals (arsenic, cadmium, chromium, and lead) were detected in at least one sediment sample in drainage from Area A through Area B. The most frequently detected metals were arsenic, chromium, and lead in 6 of 6 samples. The inorganic chemicals of potential concern, arsenic and cadmium (see Table 2-4), were detected at maximum concentrations of 27.4 J mg/kg

and 56.7 mg/kg in samples SED-05 and TRENCH 5, respectively.

Two dioxins, 1,2,3,4,7,8,9-heptachlorodibenzofuran (HpCDF) and OCDD were each detected in the single sediment sample analyzed for dioxins. The detected concentrations of HpCDF and OCDD were 8.7 μg/kg and 0.12 μg/kg, respectively, in sample TRENCH 5.

2.3 Criteria for the Selection of Chemicals of Potential Concern

Due to the large number of chemicals detected at the site, the number of chemicals retained for quantitative analysis in this risk assessment was reduced to the most significant (i.e., greatest contributors to risks/hazards). If all chemicals were retained for analysis, the resulting document would be unduly complex and could distract from the dominant risks and hazards associated with the site. Chemicals of potential concern were selected based on procedures specified in RAGS Part A (USEPA, 1989a) and on professional judgement. The primary considerations for selection or elimination were as follows:

- frequency of detection in analyzed medium (i.e., surface soil)
- historical site information/activities (i.e., site-relatedness)
- chemical concentration - toxicity screen
- sample chemical detections relative to blank chemical detections
- chemical toxicity (potential carcinogenic and noncarcinogenic effects, weight-of evidence for potential carcinogenicity)
- chemical properties (i.e., mobility, persistence, and bioaccumulation)
- significant exposure routes

The frequency of detection is defined as the number of detections (hits) divided by the total number of valid sample analyses. For all chemicals detected in a given medium, a frequency of

detection of five (5) percent was utilized as the minimum cutoff point. A number of essential nutrients such as calcium, magnesium, potassium, and sodium were detected in the site matrices. The potential toxicity of these minerals is significantly lower than other inorganics detected at the site. In general, more data are available for these minerals with regard to identifying dietary intake rather than toxicity. These minerals are also typically obtained via food, mineral supplements, etc. and are homeostatically regulated to maintain appropriate body functions. Therefore, these minerals were not selected as chemicals of potential concern in the risk assessment. In addition, the commonly detected metals aluminum, cobalt, copper, iron, and lead have been quantitatively addressed in Section 4.3 and in Appendix B of this risk assessment due to the lack of established toxicity values.

The potential health impact of a chemical is related to the relationship of concentration and toxicity. Therefore, a chemical concentration - toxicity screening procedure was performed for all chemicals detected in the specific areas of concern for surface soil, subsurface soil, ground water, surface water, and sediment to aid in the determination of which chemicals were likely to contribute significantly to potential risks and hazards (see Tables 2-12 through 2-22). Individual chemical scores (or risk factors) were calculated for each medium and area as follows:

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TABLE 2-12

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA A

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Hexachlorobenzene	no	2.00E+02	1.6E+00	3.20E+02	0.81%
Chlorobenzilate (TIC)	no	1.20E+01	2.7E-01	3.24E+00	0.01%
Chlorothalonil (TIC)	no	2.00E+01	1.1E-02	2.20E-01	0.00%
Lindane (Total)	no	3.30E+01	1.3E+00	4.29E+01	0.11%
Aldrin	YES	6.90E+01	1.7E+01	1.17E+03	2.98%
Dieldrin	YES	2.20E+03	1.6E+01	3.52E+04	89.37%
4,4'-DDE	no	2.40E+01	3.4E-01	8.16E+00	0.02%
4,4-DDD	no	3.60E+02	2.4E-01	8.64E+01	0.22%
4,4'-DDT	YES	6.80E+03	3.4E-01	2.31E+03	5.87%
Arsenic	no	1.32E+02	1.75E+00	2.31E+02	0.59%
Beryllium	no	1.80E+00	4.3E+00	7.74E+00	0.02%
OCDD *	no	1.20E-05	1.5E+05	1.80E+00	0.00%
			TOTAL RISK FACTOR =	3.94E+04	100%

* The 2,3,7,8-TCDD toxicity equivalency factor was used to evaluate the risk associated with OCDD.

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TABLE 2-12

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA A

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Phenol	no	3.60E+01	6.0E-01	6.00E+01	0.00%
Hexachlorobenzene	no	2.00E+02	8.0E-04	2.50E+05	0.41%
Di-n-butylphthalate	no	3.13E-01	1.0E-01	3.13E+00	0.00%
Benzaldehyde (TIC)	no	9.20E-02	1.0E-01	9.20E-01	0.00%
Chlorobenzilate (TIC)	no	1.20E+01	2.0E-02	6.00E+02	0.00%
Hexachlorophene (TIC)	no	2.10E+00	3.0E-04	7.00E+03	0.01%
Penoxaline (TIC)	no	4.90E-01	4.0E-02	1.23E+01	0.00%
Phthalic Anhydride (TIC)	no	3.30E+01	2.0E+00	1.65E+01	0.00%
Chlorothalonil (TIC)	no	2.00E+01	1.5E-02	1.33E+03	0.00%
Lindane (Total)	no	3.30E+01	3.0E-04	1.10E+05	0.18%
Aldrin	YES	6.90E+01	3.0E-05	2.30E+06	3.78%
Endosulfan I	no	4.38E-02	6.0E-03	7.29E+00	0.00%
Dieldrin	YES	2.20E+03	5.0E-05	4.40E+07	72.34%
Endrin (Total)	no	3.55E-01	3.0E-04	1.18E+03	0.00%
4,4'-DDT	YES	6.80E+03	5.0E-04	1.36E+07	22.36%
Methoxychlor	no	4.90E+00	5.0E-03	9.80E+02	0.00%
Sevin	no	5.10E-01	1.0E-01	5.10E+00	0.00%
Malathion	no	2.60E-01	2.0E-02	1.30E+01	0.00%
Arsenic	no	1.32E+02	3.0E-04	4.40E+05	0.72%
Barium	no	7.90E+01	7.0E-02	1.13E+03	0.00%
Beryllium	no	1.80E+00	5.0E-03	3.60E+02	0.00%
Cadmium	no	6.30E+00	1.0E-03	6.30E+03	0.01%
Chromium III	no	9.65E+00	1.0E+00	9.65E+00	0.00%
Chromium VI	no	2.20E+00	5.0E-03	4.40E+02	0.00%
Manganese	no	3.31E+02	5.0E-03	6.62E+04	0.11%
Mercury	no	9.40E-01	3.0E-04	3.13E+03	0.01%
Nickel	no	9.80E+00	2.0E-02	4.90E+02	0.00%
Selenium	no	1.52E+01	5.0E-03	3.04E+03	0.00%
Thallium	no	2.30E+00	8.0E-05	2.88E+04	0.05%
Vanadium	no	3.38E+01	7.0E-03	4.83E+03	0.01%
Zinc	no	8.85E+01	3.0E-01	2.95E+02	0.00%
			TOTAL RISK FACTOR =	6.08E+07	100%

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TABLE 2-13

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA B

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Benzo(a)anthracene	no	2.05E+00	7.3E-01	1.50E+00	1.00%
Chrysene	no	3.00E+00	7.3E-03	2.19E-02	0.01%
Benzo(b)fluoranthene	YES	4.85E+00	7.3E-01	3.54E+00	2.36%
Benzo(k)fluoranthene	no	1.70E+00	7.3E-02	1.24E-01	0.08%
Benzo(a)pyrene	YES	1.30E+00	7.3E+00	9.49E+00	6.31%
Indeno(1,2,3-cd)pyrene	no	9.75E-01	7.3E-01	7.12E-01	0.47%
Chlorobenzilate (TIC)	no	1.70E+00	2.7E-01	4.59E-01	0.31%
beta-BHC	no	3.05E-01	1.8E+00	5.49E-01	0.37%
4,4'-DDE	YES	2.00E+01	3.4E-01	6.80E+00	4.52%
4,4'-DDD	YES	1.50E+01	2.4E-01	3.60E+00	2.39%
4,4'-DDT	YES	2.80E+02	3.4E-01	9.52E+01	63.33%
Arsenic	YES	1.53E+01	1.75E+00	2.67E+01	17.75%
OCDD *	YES	1.10E-05	1.5E+05	1.65E+00	1.10%
			TOTAL RISK FACTOR =	1.50E+02	100%

* The 2,3,7,8-TCDD toxicity equivalency factor was used to evaluate the risk associated with OCDD.

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TABLE 2-13

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA B

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Fluoranthene	no	3.55E+00	4.0E-02	8.88E+01	0.01%
Pyrene	no	2.95E+00	3.0E-02	9.83E+01	0.02%
Chlorobenzilate (TIC)	no	1.70E+00	2.0E-02	8.50E+01	0.01%
4,4'-DDT	YES	2.80E+02	5.0E-04	5.60E+05	85.72%
Endosulfan I	no	4.18E-01	6.0E-03	6.96E+01	0.01%
Sevin	no	4.21E+00	1.0E-01	4.21E+01	0.01%
Malathion	no	1.90E-02	2.0E-02	9.50E-01	0.00%
Arsenic	YES	1.53E+01	3.0E-04	5.08E+04	7.78%
Barium	no	6.31E+01	7.0E-02	9.01E+02	0.14%
Chromium III	no	2.23E+01	1.0E+00	2.23E+01	0.00%
Chromium VI	no	3.10E+00	5.0E-03	6.20E+02	0.09%
Manganese	YES	1.59E+02	5.0E-03	3.18E+04	4.87%
Mercury	no	1.10E+00	3.0E-04	3.67E+03	0.56%
Nickel	no	8.60E+00	2.0E-02	4.30E+02	0.07%
Selenium	no	1.10E+00	5.0E-03	2.20E+02	0.03%
Vanadium	no	2.93E+01	7.0E-03	4.19E+03	0.64%
Zinc	no	6.96E+01	3.0E-01	2.32E+02	0.04%
			TOTAL RISK FACTOR =	6.53E+05	100%

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TABLE 2-14

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA C

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
4,4'-DDE	no	1.20E+00	3.4E-01	4.08E-01	0.90%
4,4'-DDD	no	5.00E-01	2.4E-01	1.20E-01	0.27%
4,4'-DDT	YES	3.80E+00	3.4E-01	1.29E+00	2.86%
Chlorobenzilate (TIC)	no	2.40E-01	2.7E-01	6.48E-02	0.14%
Arsenic	YES	2.27E+01	1.75E+00	3.97E+01	87.94%
Beryllium	YES	3.40E-01	4.3E+00	1.46E+00	3.24%
OCDD *	YES	1.40E-05	1.5E+05	2.10E+00	4.65%
			TOTAL RISK FACTOR =	4.52E+01	100%

* The 2,3,7,8-TCDD toxicity equivalency factor was used to evaluate the risk associated with OCDD.

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TABLE 2-14

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA C

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Di-n-butylphthalate	no	2.21E+00	1.0E-01	2.21E+01	0.01%
Chlorobenzilate (TIC)	no	2.40E-01	2.0E-02	1.20E+01	0.01%
4,4'-DDT	YES	3.80E+00	5.0E-04	7.60E+03	5.11%
Arsenic	YES	2.27E+01	3.0E-04	7.57E+04	50.92%
Barium	no	3.65E+01	7.0E-02	5.21E+02	0.35%
Beryllium	no	3.40E-01	5.0E-03	6.80E+01	0.05%
Chromium III	no	1.69E+01	1.0E+00	1.69E+01	0.01%
Chromium VI	no	1.40E+00	5.0E-03	2.80E+02	0.19%
Manganese	YES	2.85E+02	5.0E-03	5.70E+04	38.36%
Nickel	no	8.30E+00	2.0E-02	4.15E+02	0.28%
Selenium	no	9.90E-01	5.0E-03	1.98E+02	0.13%
Vanadium	YES	4.64E+01	7.0E-03	6.63E+03	4.46%
Zinc	no	5.13E+01	3.0E-01	1.71E+02	0.12%
			TOTAL RISK FACTOR =	1.49E+05	100%

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TABLE 2-15

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA A AND AREA C (COMBINED)

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Hexachlorobenzene	no	2.00E+02	1.6E+00	3.20E+02	0.81%
Chlorobenzilate (TIC)	no	1.20E+01	2.7E-01	3.24E+00	0.01%
Chlorothalonil (TIC)	no	2.00E+01	1.1E-02	2.20E-01	0.00%
Lindane (Total)	no	3.30E+01	1.3E+00	4.29E+01	0.11%
Aldrin	YES	6.90E+01	1.7E+01	1.17E+03	2.98%
Dieldrin	YES	2.20E+03	1.6E+01	3.52E+04	89.37%
4,4'-DDE	no	2.40E+01	3.4E-01	8.16E+00	0.02%
4,4'-DDD	no	3.60E+02	2.4E-01	8.64E+01	0.22%
4,4'-DDT	YES	6.80E+03	3.4E-01	2.31E+03	5.87%
Arsenic	no	1.32E+02	1.75E+00	2.31E+02	0.59%
Beryllium	no	1.80E+00	4.3E+00	7.74E+00	0.02%
OCDD *	no	1.40E-05	1.5E+05	2.10E+00	0.01%
			TOTAL RISK FACTOR =	3.94E+04	100%

* The 2,3,7,8-TCDD toxicity equivalency factor was used to evaluate the risk associated with OCDD.

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TABLE 2-15

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE SOIL - AREA A AND AREA C (COMBINED)

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Phenol	no	3.60E+01	6.0E-01	6.00E+01	0.00%
Hexachlorobenzene	no	2.00E+02	8.0E-04	2.50E+05	0.41%
Di-n-butylphthalate	no	2.21E+00	1.0E-01	2.21E+01	0.00%
Benzaldehyde (TIC)	no	9.20E-02	1.0E-01	9.20E-01	0.00%
Chlorobenzilate (TIC)	no	1.20E+01	2.0E-02	6.00E+02	0.00%
Hexachlorophene (TIC)	no	2.10E+00	3.0E-04	7.00E+03	0.01%
Penoxaline (TIC)	no	4.90E-01	4.0E-02	1.23E+01	0.00%
Phthalic Anhydride (TIC)	no	3.30E+01	2.0E+00	1.65E+01	0.00%
Chlorothalonil (TIC)	no	2.00E+01	1.5E-02	1.33E+03	0.00%
Lindane (Total)	no	3.30E+01	3.0E-04	1.10E+05	0.18%
Aldrin	YES	6.90E+01	3.0E-05	2.30E+06	3.78%
Endosulfan I	no	4.38E-02	6.0E-03	7.29E+00	0.00%
Dieldrin	YES	2.20E+03	5.0E-05	4.40E+07	72.33%
Endrin (Total)	no	3.55E-01	3.0E-04	1.18E+03	0.00%
4,4'-DDT	YES	6.80E+03	5.0E-04	1.36E+07	22.36%
Methoxychlor	no	4.90E+00	5.0E-03	9.80E+02	0.00%
Sevin	no	5.10E-01	1.0E-01	5.10E+00	0.00%
Malathion	no	2.60E-01	2.0E-02	1.30E+01	0.00%
Arsenic	no	1.32E+02	3.0E-04	4.40E+05	0.72%
Barium	no	7.90E+01	7.0E-02	1.13E+03	0.00%
Beryllium	no	1.80E+00	5.0E-03	3.60E+02	0.00%
Cadmium	no	6.30E+00	1.0E-03	6.30E+03	0.01%
Chromium III	no	9.65E+01	1.0E+00	9.65E+01	0.00%
Chromium VI	no	2.20E+00	5.0E-03	4.40E+02	0.00%
Manganese	no	3.31E+02	5.0E-03	6.62E+04	0.11%
Mercury	no	9.40E-01	3.0E-04	3.13E+03	0.01%
Nickel	no	9.80E+00	2.0E-02	4.90E+02	0.00%
Selenium	no	1.52E+01	5.0E-03	3.04E+03	0.00%
Thallium	no	2.30E+00	8.0E-05	2.88E+04	0.05%
Vanadium	no	4.64E+01	7.0E-03	6.63E+03	0.01%
Zinc	no	8.85E+01	3.0E-01	2.95E+02	0.00%
			TOTAL RISK FACTOR =	6.08E+07	100%

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TABLE 2-16

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SUBSURFACE SOIL - AREA A

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Methylene Chloride	no	1.10E-01	7.5E-03	8.25E-04	0.00%
alpha-BHC	YES	1.47E+01	6.3E+00	9.26E+01	6.39%
beta-BHC	no	2.30E+00	1.8E+00	4.14E+00	0.29%
Lindane (Total)	no	6.00E+00	1.3E+00	7.80E+00	0.54%
Aldrin	YES	6.90E+00	1.7E+01	1.17E+02	8.09%
Dieldrin	YES	6.39E+01	1.6E+01	1.02E+03	70.50%
4,4'-DDE	no	8.20E+00	3.4E-01	2.79E+00	0.19%
4,4'-DDD	no	2.20E+01	2.4E-01	5.28E+00	0.36%
4,4'-DDT	YES	4.42E+02	3.4E-01	1.50E+02	10.36%
Arsenic	YES	2.48E+01	1.75E+00	4.34E+01	2.99%
Beryllium	no	1.00E+00	4.3E+00	4.30E+00	0.30%
			TOTAL RISK FACTOR =	1.45E+03	100%

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TABLE 2-16

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SUBSURFACE SOIL - AREA A

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Methylene Chloride	no	1.10E-01	6.0E-02	1.83E+00	0.00%
Acetone	no	9.50E-02	1.0E-01	9.50E-01	0.00%
Toluene	no	7.00E-03	2.0E-01	3.50E-02	0.00%
Phenol	no	8.10E-01	6.0E-01	1.35E+00	0.00%
Di-n-butylphthalate	no	4.20E+00	1.0E-01	4.20E+01	0.00%
Lindane (Total)	no	6.00E+00	3.0E-04	2.00E+04	0.79%
Aldrin	YES	6.90E+00	3.0E-05	2.30E+05	9.04%
Endosulfan I	no	2.30E-01	6.0E-03	3.83E+01	0.00%
Dieldrin	YES	6.39E+01	5.0E-05	1.28E+06	50.24%
4,4'-DDT	YES	4.42E+02	5.0E-04	8.84E+05	34.75%
Sevin	no	2.30E+02	1.0E-01	2.30E+03	0.09%
Malathion	no	7.00E-02	2.0E-02	3.50E+00	0.00%
Arsenic	YES	2.48E+01	3.0E-04	8.27E+04	3.25%
Barium	no	7.00E+01	7.0E-02	1.00E+03	0.04%
Beryllium	no	1.00E+00	5.0E-03	2.00E+02	0.01%
Chromium III	no	4.03E+01	1.0E+00	4.03E+01	0.00%
Chromium VI	no	6.71E+00	5.0E-03	1.34E+03	0.05%
Manganese	YES	1.84E+02	5.0E-03	3.68E+04	1.45%
Mercury	no	1.20E-01	3.0E-04	4.00E+02	0.02%
Nickel	no	1.10E+01	2.0E-02	5.50E+02	0.02%
Selenium	no	9.00E-01	5.0E-03	1.80E+02	0.01%
Vanadium	no	4.10E+01	7.0E-03	5.86E+03	0.23%
Zinc	no	9.00E+01	3.0E-01	3.00E+02	0.01%
			TOTAL RISK FACTOR =	2.54E+06	100%

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TABLE 2-17

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SUBSURFACE SOIL - AREA B

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Bis(2-ethylhexyl)phthalate	no	1.40E+00	1.4E-02	1.96E-02	0.00%
alpha-BHC	no	1.20E-02	6.3E+00	7.56E-02	0.01%
beta-BHC	no	1.80E-01	1.8E+00	3.24E-01	0.06%
4,4'-DDE	YES	2.26E+02	3.4E-01	7.68E+01	15.09%
4,4'-DDD	no	1.94E+00	2.4E-01	4.66E-01	0.09%
4,4'-DDT	YES	1.24E+03	3.4E-01	4.22E+02	82.82%
Arsenic	YES	3.60E+00	1.75E+00	6.30E+00	1.24%
Beryllium	no	8.00E-01	4.3E+00	3.44E+00	0.68%
			TOTAL RISK FACTOR =	5.09E+02	100%

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TABLE 2-17

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SUBSURFACE SOIL - AREA B

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Acetone	no	4.60E-02	1.0E-01	4.60E-01	0.00%
Butylbenzylphthalate	no	1.00E+00	2.0E-01	5.00E+00	0.00%
Bis(2-ethylhexyl)phthalate	no	1.40E+00	2.0E-02	7.00E+01	0.00%
4,4'-DDT	YES	1.24E+03	5.0E-04	2.48E+06	98.82%
Arsenic	no	3.60E+00	3.0E-04	1.20E+04	0.48%
Beryllium	no	8.00E-01	5.0E-03	1.60E+02	0.01%
Chromium III	no	1.46E+01	1.0E+00	1.46E+01	0.00%
Chromium VI	no	2.43E+00	5.0E-03	4.86E+02	0.02%
Manganese	no	6.30E+01	5.0E-03	1.26E+04	0.50%
Mercury	no	8.00E-02	3.0E-04	2.67E+02	0.01%
Nickel	no	6.00E+00	2.0E-02	3.00E+02	0.01%
Vanadium	no	2.60E+01	7.0E-03	3.71E+03	0.15%
Zinc	no	1.40E+01	3.0E-01	4.67E+01	0.00%
			TOTAL RISK FACTOR =	2.51E+06	100%

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TABLE 2-18

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
GROUND WATER (SITE-WIDE, SATURATED SURFICIAL AQUIFER)

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/l)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Chloroform	no	1.45E-02	6.1E-03	8.85E-05	0.00%
Carbon Tetrachloride	no	7.25E-03	1.3E-01	9.43E-04	0.05%
Benzene	no	1.50E-02	2.9E-02	4.35E-04	0.02%
Tetrachloroethene	no	1.40E-01	5.2E-02	7.28E-03	0.39%
alpha-BHC	YES	6.90E-02	6.3E+00	4.35E-01	23.26%
beta-BHC	no	6.00E-03	1.8E+00	1.08E-02	0.58%
Lindane (Total)	YES	3.35E-02	1.3E+00	4.36E-02	2.33%
Dieldrin	YES	1.35E-03	1.6E+01	2.16E-02	1.16%
4,4'-DDD	no	2.00E-04	2.4E-01	4.80E-05	0.00%
4,4'-DDT	no	1.10E-04	3.4E-01	3.74E-05	0.00%
gamma-Chlordane	no	5.00E-05	1.3E+00	6.50E-05	0.00%
Arsenic	YES	7.71E-01	1.75E+00	1.35E+00	72.20%
			TOTAL RISK FACTOR =	1.87E+00	100%

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TABLE 2-18

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
GROUND WATER (SITE-WIDE, SATURATED SURFICIAL AQUIFER)

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/l)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Acetone	no	1.20E+00	1.0E-01	1.20E+01	0.41%
Chloroform	no	1.45E-02	1.0E-02	1.45E+00	0.05%
Carbon Tetrachloride	no	7.25E-03	7.0E-04	1.04E+01	0.35%
Tetrachloroethene	no	1.40E-01	1.0E-02	1.40E+01	0.48%
Chlorobenzene	no	4.90E-02	2.0E-02	2.45E+00	0.08%
Ethylbenzene	no	1.10E-02	1.0E-01	1.10E-01	0.00%
Xylenes (Total)	no	8.95E-02	2.0E+00	4.48E-02	0.00%
4-Methylphenol	no	1.00E-02	5.0E-03	2.00E+00	0.07%
Naphthalene	no	1.70E-01	4.0E-02	4.25E+00	0.15%
Diethylphthalate	no	1.45E-02	8.0E-01	1.81E-02	0.00%
Cumene (TIC)	no	1.60E-01	4.0E-02	4.00E+00	0.14%
Diphenamid (TIC)	no	5.80E-01	3.0E-02	1.93E+01	0.66%
Propham (TIC)	no	2.00E-01	2.0E-02	1.00E+01	0.34%
Lindane (Total)	YES	3.35E-02	3.0E-04	1.12E+02	3.82%
Dieldrin	no	1.35E-03	5.0E-05	2.70E+01	0.92%
Endrin (Total)	no	1.50E-04	3.0E-04	5.00E-01	0.02%
4,4'-DDT	no	1.10E-04	5.0E-04	2.20E-01	0.01%
gamma-chlordane	no	5.00E-05	6.0E-05	8.33E-01	0.03%
Sevin	no	1.40E+00	1.0E-01	1.40E+01	0.48%
Malathion	no	5.50E-03	2.0E-02	2.75E-01	0.01%
Arsenic	YES	7.71E-01	3.0E-04	2.57E+03	87.95%
Cadmium	YES	5.46E-02	5.0E-04	1.09E+02	3.73%
Chromium III	no	4.44E+00	1.0E+00	4.44E+00	0.15%
Chromium VI	no	2.00E-02	5.0E-03	4.00E+00	0.14%
			TOTAL RISK FACTOR =	2.92E+03	100%

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TABLE 2-19

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE WATER - DRAINAGE FROM AREA A THROUGH AREA C

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/l)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
alpha-BHC	YES	2.50E-02	6.3E+00	1.58E-01	60.07%
beta-BHC	YES	3.20E-03	1.8E+00	5.76E-03	2.20%
Lindane (Total)	YES	1.80E-02	1.3E+00	2.34E-02	8.93%
Dieldrin	YES	3.50E-03	1.6E+01	5.60E-02	21.36%
4,4'-DDE	no	1.90E-03	3.4E-01	6.46E-04	0.25%
4,4'-DDD	no	8.40E-03	2.4E-01	2.02E-03	0.77%
4,4'-DDT	YES	2.90E-02	3.4E-01	9.86E-03	3.76%
Arsenic	YES	4.00E-03	1.75E+00	7.00E-03	2.67%
			TOTAL RISK FACTOR =	2.62E-01	100%

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TABLE 2-19

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE WATER - DRAINAGE FROM AREA A THROUGH AREA C

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/l)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Acetone	no	1.60E-02	1.0E-01	1.60E-01	0.06%
Xylenes (Total)	no	9.20E-02	2.0E+00	4.60E-02	0.02%
Cumene (TIC)	no	4.00E-03	4.0E-02	1.00E-01	0.04%
Diphenamid (TIC)	no	2.50E-02	3.0E-02	8.33E-01	0.30%
Prophan (TIC)	no	7.00E-03	2.0E-02	3.50E-01	0.13%
Lindane (Total)	YES	1.80E-02	3.0E-04	6.00E+01	21.52%
Dieldrin	YES	3.50E-03	5.0E-05	7.00E+01	25.11%
4,4'-DDT	YES	2.90E-02	5.0E-04	5.80E+01	20.81%
Methoxychlor	YES	2.60E-02	5.0E-03	5.20E+00	1.87%
Sevin	no	6.40E-02	1.0E-01	6.40E-01	0.23%
Malathion	no	6.70E-04	2.0E-02	3.35E-02	0.01%
Arsenic	YES	4.00E-03	3.0E-04	1.33E+01	4.78%
Cadmium	YES	3.49E-02	5.0E-04	6.98E+01	25.04%
Chromium III	no	8.60E-03	1.0E+00	8.60E-03	0.00%
Chromium VI	no	1.34E-03	5.0E-03	2.68E-01	0.10%
			TOTAL RISK FACTOR =	2.79E+02	100%

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TABLE 2-20

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE WATER - DRAINAGE FROM AREA A THROUGH AREA B

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/l)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Bis(2-ethylhexyl)phthalate	no	1.60E-02	1.4E-02	2.24E-04	0.02%
Ethylene thiourea (TIC)	no	2.80E-02	1.1E-01	3.08E-03	0.27%
alpha-BHC	YES	3.80E-03	6.3E+00	2.39E-02	2.10%
beta-BHC	no	7.70E-04	1.8E+00	1.39E-03	0.12%
Lindane (Total)	no	5.30E-04	1.3E+00	6.89E-04	0.06%
Dieldrin	YES	1.00E-03	1.6E+01	1.60E-02	1.40%
4,4'-DDE	no	4.60E-03	3.4E-01	1.56E-03	0.14%
4,4'-DDD	YES	5.00E-02	2.4E-01	1.20E-02	1.05%
4,4'-DDT	no	1.10E-02	3.4E-01	3.74E-03	0.33%
Arsenic	YES	6.16E-01	1.75E+00	1.08E+00	94.51%
			TOTAL RISK FACTOR =	1.14E+00	100%

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TABLE 2-20

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SURFACE WATER - DRAINAGE FROM AREA A THROUGH AREA B

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/l)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Fluoranthene	no	1.30E-02	4.0E-02	3.25E-01	0.00%
Pyrene	no	1.20E-02	3.0E-02	4.00E-01	0.00%
Bis(2-ethylhexyl)phthalate	no	1.60E-02	2.0E-02	8.00E-01	0.00%
Ethylene thiourea (TIC)	YES	2.80E-02	8.0E-05	3.50E+02	1.96%
Lindane (Total)	no	5.30E-04	3.0E-04	1.77E+00	0.01%
Dieldrin	no	1.00E-03	5.0E-05	2.00E+01	0.11%
4,4'-DDT	no	1.10E-02	5.0E-04	2.20E+01	0.12%
Sevin	no	2.30E-02	1.0E-01	2.30E-01	0.00%
Arsenic	YES	6.16E-01	3.0E-04	2.05E+03	11.52%
Cadmium	no	6.52E-02	5.0E-04	1.30E+02	0.73%
Chromium III	YES	4.44E+02	1.0E+00	4.44E+02	2.49%
Chromium VI	YES	7.40E+01	5.0E-03	1.48E+04	83.04%
			TOTAL RISK FACTOR =	1.78E+04	100%

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TABLE 2-21

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SEDIMENT - DRAINAGE FROM AREA A THROUGH AREA C

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Methylene Chloride	no	9.30E-02	7.5E-03	6.98E-04	0.00%
Benzene	no	1.00E-02	2.9E-02	2.90E-04	0.00%
Tetrachloroethene	no	1.00E-02	5.2E-02	5.20E-04	0.00%
Bis(2-ethylhexyl)phthalate	no	4.20E-01	1.4E-02	5.88E-03	0.01%
alpha-BHC	YES	5.50E-01	6.3E+00	3.47E+00	4.15%
beta-BHC	no	3.50E-01	1.8E+00	6.30E-01	0.75%
Lindane (Total)	no	3.20E-01	1.3E+00	4.16E-01	0.50%
Dieldrin	YES	6.20E-01	1.6E+01	9.92E+00	11.88%
4,4'-DDE	YES	2.63E+00	3.4E-01	8.93E-01	1.07%
4,4'-DDD	YES	3.10E+01	2.4E-01	7.44E+00	8.91%
4,4'-DDT	YES	1.20E+02	3.4E-01	4.08E+01	48.85%
Arsenic	YES	1.14E+01	1.75E+00	2.00E+01	23.89%
			TOTAL RISK FACTOR =	8.35E+01	100%

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TABLE 2-21

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SEDIMENT - DRAINAGE FROM AREA A THROUGH AREA C

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Methylene Chloride	no	9.30E-02	6.0E-02	1.55E+00	0.00%
Acetone	no	4.80E-02	1.0E-01	4.80E-01	0.00%
Tetrachloroethene	no	1.00E-02	1.0E-02	1.00E+00	0.00%
Chlorobenzene	no	3.20E-02	2.0E-02	1.60E+00	0.00%
Ethylbenzene	no	1.00E-02	1.0E-01	1.00E-01	0.00%
Xylenes (Total)	no	9.80E-02	2.0E+00	4.90E-02	0.00%
Phenol	no	2.50E+00	6.0E-01	4.17E+00	0.00%
4-Chloroaniline	no	4.58E+00	4.0E-03	1.14E+03	0.35%
Bis(2-ethylhexyl)phthalate	no	4.20E-01	2.0E-02	2.10E+01	0.01%
Phthalic anhydride (TIC)	no	9.20E-01	2.0E+00	4.60E-01	0.00%
Lindane (Total)	no	3.20E-01	3.0E-04	1.07E+03	0.33%
Dieldrin	YES	6.20E-01	5.0E-05	1.24E+04	3.84%
4,4'-DDT	YES	1.20E+02	5.0E-04	2.40E+05	74.36%
Methoxychlor	YES	4.50E+01	5.0E-03	9.00E+03	2.79%
Sevin	no	5.40E-01	1.0E-01	5.40E+00	0.00%
Malathion	no	4.40E-01	2.0E-02	2.20E+01	0.01%
Arsenic	YES	1.14E+01	3.0E-04	3.80E+04	11.77%
Cadmium	YES	4.30E+00	1.0E-03	4.30E+03	1.33%
Chromium III	no	1.71E+01	1.0E+00	1.71E+01	0.01%
Chromium VI	no	2.84E+00	5.0E-03	5.68E+02	0.18%
Manganese	YES	6.00E+01	5.0E-03	1.20E+04	3.72%
Mercury	no	2.10E-01	3.0E-04	7.00E+02	0.22%
Nickel	no	7.00E+00	2.0E-02	3.50E+02	0.11%
Selenium	no	4.30E+00	5.0E-03	8.60E+02	0.27%
Vanadium	no	9.00E+00	7.0E-03	1.29E+03	0.40%
Zinc	no	3.04E+02	3.0E-01	1.01E+03	0.31%
Cyanide	no	2.00E-01	2.0E-02	1.00E+01	0.00%
			TOTAL RISK FACTOR =	3.23E+05	100%

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TABLE 2-22

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SEDIMENT - DRAINAGE FROM AREA A THROUGH AREA B

CARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Slope Factor (mg/kg-day)-1	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
N-Nitrosodiphenylamine	no	2.90E+00	4.9E-03	1.42E-02	0.00%
Benzo(a)anthracene	YES	2.20E+01	7.3E-01	1.61E+01	5.38%
Chrysene	no	2.00E+01	7.3E-03	1.46E-01	0.05%
Benzo(b)fluoranthene	YES	2.40E+01	7.3E-01	1.75E+01	5.87%
Benzo(k)fluoranthene	no	1.20E+01	7.3E-02	8.76E-01	0.29%
Benzo(a)pyrene	YES	1.80E+01	7.3E+00	1.31E+02	44.05%
alpha-BHC	YES	7.50E-01	6.3E+00	4.73E+00	1.58%
beta-BHC	no	2.10E-01	1.8E+00	3.78E-01	0.13%
Dieldrin	YES	3.20E+00	1.6E+01	5.12E+01	17.16%
4,4'-DDE	no	1.00E+00	3.4E-01	3.40E-01	0.11%
4,4'-DDD	no	6.70E+00	2.4E-01	1.61E+00	0.54%
4,4'-DDT	YES	4.00E+01	3.4E-01	1.36E+01	4.56%
Arsenic	YES	2.74E+01	1.75E+00	4.80E+01	16.07%
PCNB	YES	4.80E+01	2.6E-01	1.25E+01	4.18%
OCDD *	no	1.20E-07	1.5E+05	1.80E-02	0.01%
			TOTAL RISK FACTOR =	2.98E+02	100%

* The 2,3,7,8-TCDD toxicity equivalency factor was used to evaluate the risk associated with OCDD.

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TABLE 2-22

PULVERIZING SERVICES SITE
CHEMICAL CONCENTRATION - TOXICITY SCREEN
SEDIMENT - DRAINAGE FROM AREA A THROUGH AREA B

NONCARCINOGENS:

CHEMICAL	Chemical of Potential Concern (Contributes >1%)	Maximum Detected Concentration (mg/kg)	Reference Dose (mg/kg-day)	Risk Factor (unitless)	Contribution to Total Risk for Matrix (Percent)
Acenaphthene	no	1.50E+00	6.0E-02	2.50E+01	0.01%
Fluorene	no	1.80E+00	4.0E-02	4.50E+01	0.01%
Anthracene	no	9.00E+00	3.0E-01	3.00E+01	0.01%
Fluoranthene	no	4.50E+01	4.0E-02	1.13E+03	0.35%
Pyrene	no	3.30E+01	3.0E-02	1.10E+03	0.34%
Endosulfan I	no	3.10E-02	6.0E-03	5.17E+00	0.00%
Dieldrin	YES	3.20E+00	5.0E-05	6.40E+04	19.77%
4,4'-DDT	YES	4.00E+01	5.0E-04	8.00E+04	24.72%
Methoxychlor	YES	2.80E+01	5.0E-03	5.60E+03	1.73%
Sevin	no	9.60E+00	1.0E-01	9.60E+01	0.03%
Malathion	no	1.70E-01	2.0E-02	8.50E+00	0.00%
Rotenone	YES	3.00E+01	4.0E-03	7.50E+03	2.32%
Arsenic	YES	2.74E+01	3.0E-04	9.13E+04	28.22%
Cadmium	YES	5.67E+01	1.0E-03	5.67E+04	17.52%
Chromium III	no	7.73E+01	1.0E+00	7.73E+01	0.02%
Chromium VI	no	1.29E+01	1.0E+00	5.00E-03	0.00%
PCNB	YES	4.80E+01	3.0E-03	1.60E+04	4.94%
			TOTAL RISK FACTOR =	3.24E+05	100%

$R_{ij} = (C_{ij})\ (T_{ij})$

Where:

R_{ij} = risk factor for chemical i in medium j;

C_{ij} = concentration of chemical i in medium j; and

T_{ij} = toxicity value for chemical i in medium j;

(i.e., slope factor or 1/oral reference dose)

For conservatism, the maximum detected concentration of each chemical was used in the calculation (USEPA, 1989a). However, for samples having a duplicate analysis, the two values were averaged except when one value was more than approximately two times the other and when one-half of the sample quantitation limit (SQL) for a non-detect was higher than the actual detection. In these cases, the maximum detection was used or the SQL was ignored and the actual detection was utilized for the sample result. Chemicals other than essential nutrients, without established toxicity values (e.g., copper, lead) could not be screened; however, they were not eliminated as chemicals of potential concern in from the risk assessment for this reason. These chemicals were evaluated qualitatively as part of Section 4.3 and Appendix B.

The chemical-specific risk factors per area for surface soil, subsurface soil, ground water, surface water, and sediment were summed to obtain a total risk factor for all chemicals for each area. Separate total risk factors were calculated for carcinogens (using the appropriate slope factors) and noncarcinogens (using the appropriate oral reference doses). The ratio of the risk factor for each

chemical in each area in a medium to the total risk factor for each area in a medium provided the relative contribution from each chemical in each area in a medium. A contribution of one percent was used as a lower limit so that the chemicals contributing at least 95 percent to the total risk per area per medium were retained.

The potential toxicity of each chemical to human health was qualitatively evaluated based on a review of acute and chronic noncarcinogenic effects, toxicity endpoint/target organ, potential carcinogenicity, and weight-of-evidence classification for potential carcinogenicity.

For the purposes of clarity, presented below is the USEPA's weight-of-evidence classification system for carcinogenicity (USEPA, 1989a).

Group A:	Human Carcinogen
Group B1 or B2:	Probable Human Carcinogen B1 indicates that limited human data are available B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
Group C:	Possible Human Carcinogen
Group D:	Not Classifiable as to human carcinogenicity
Group E:	Evidence of noncarcinogenicity in humans

Chemicals given a Group A weight-of-evidence classification were retained for conservatism even if they were detected at low concentrations. This is based on the fact that the weight-of-evidence classification is an indication of the quality and quantity of data underlying a chemical's designation as a potential human carcinogen.

For the evaluation of chromium in this risk assessment, total chromium and in some samples hexavalent chromium were analyzed for in soils, ground water, surface water, and sediment matrices. Hexavalent chromium sample results were used in calculations when available, otherwise, total chromium was speciated into its +3 and +6 valence states using a ratio of 6:1, respectively, per the IRIS data base (on-line June 1995). In addition, carcinogenic PAHs were evaluated using the slope factor for benzo(a)pyrene in conjunction with relative potency values per USEPA's Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (1993a). Only those noncarcinogenic PAHs having available toxicity values could be evaluated using the screening procedure. Table 2-23 presents a summary of PAH classification.

For the evaluation of dioxins in this risk assessment, USEPA's interim procedures for deriving 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalence concentrations (USEPA, 1989c) were applied to soil and sediment data for the Pulverizing Services site. The 2,3,7,8-TCDD toxicity equivalence concentrations were derived by multiplying the concentration of the individual dioxin/furan congeners (in this risk assessment octachlorodibenzo-p-dioxin (OCDD) and 1,2,3,4,7,8,9-heptachlorodibenzofuran (1,2,3,4,7,8,9-HpCDF)) by a Toxicity Equivalence Factor (TEF). The TEFs range from zero for mono, di-, tri-, and octachlorinated dibenzo-p-dioxins and -dibenzofurans (CDDs and CDFs) to 1 for 2,3,7,8-TCDD. For OCDD, a TEF of 0.001 was applied while for 1,2,3,4,7,8,9-HpCDF a TEF of zero was applied. These 2,3,7,8-TCDD toxicity equivalence concentrations are reported in surface soil and sediment chemical concentration-toxicity screens and spreadsheets as appropriate (i.e., for those areas having dioxin

TABLE 2-23

PULVERIZING SERVICES SITE

POLYCYCLIC AROMATIC HYDROCARBON COMPOUND CLASSIFICATION

The following PAHs detected at the site were considered carcinogenic or noncarcinogenic:

Carcinogenic:		Weight-of-Evidence Classification	Relative Potency Values
Benzo(a)anthracene	-	B2	0.1
Benzo(b)fluoranthene	-	B2	0.1
Benzo(k)fluoranthene	-	B2	0.01
Benzo(a)pyrene	-	B2	1.0
Chrysene	-	B2	0.001
Dibenzo(a,h)anthracene	-	B2	1.0
Indeno(1,2,3-cd)pyrene	-	B2	0.1

Noncarcinogenic:		Weight-of-Evidence Classification
Acenaphthene	-	*
Anthracene	-	D
Benzo(g,h,i)perylene	-	D
Fluoranthene	-	D
Fluorene	-	D
2-Methylnaphthalene	-	*
Naphthalene	-	D
Phenanthrene	-	D
Pyrene	-	D

B2: Indicates sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans.

D: Not classifiable as to human carcinogenicity.

*: No classification is specified in the listed sources.

Sources: USEPA, 1992b, USEPA, 1994, and USEPA, 1995.

detections).

2.3.1 Blank Concentrations

Blanks are quality control samples used to measure contamination introduced into a sample either in the field or in the laboratory. Field and trip blank water samples were prepared for the Pulverizing Services site. While trip blank samples are routinely analyzed for VOCs only, field blanks were analyzed for additional chemicals including SVOCs, pesticides (including Sevin, Malathion, and rotenone), PCBs, select metals, the fungicide PCNB, and dioxins. The organic chemicals acetone, 2-butanone (methyl ethyl ketone), methylene chloride, toluene, and the phthalate esters are considered by the USEPA to be common laboratory contaminants in all environmental media.

Soil: The only chemicals of potential concern selected for site surface and subsurface soils which were detected in the associated field blank samples were the pesticides dieldrin and 4,4'-DDT. Dieldrin was detected in one field blank sample at a concentration of 0.01 J μg/l. 4,4'-DDT was detected in three field blank samples at a maximum concentration of 0.12 μg/l.

The soil concentrations of pesticides are reported in the unit μg/kg which cannot be directly compared to the field blank (water) pesticide concentrations which are reported in the unit μg/l.

Ground Water: None of the chemicals of potential concern selected for ground water were

detected in the associated field and trip blanks.

Surface Water: None of the chemicals of potential concern selected for surface water were detected in the associated trip blanks.

Sediment: The only chemical of potential concern selected for sediment which was detected in the associated field and/or trip blanks was 4,4'-DDT. 4,4'-DDT was detected in one field blank sample, associated with the STORM-1 sample, at a concentration of 0.012 JPB μg/l.

The sediment concentrations of pesticides are reported in the unit μg/kg which cannot be directly compared to the field blank (water) pesticide concentrations which are reported in the unit μg/l.

2.3.2 Background Concentrations

A comparison of site soil concentrations with representative background concentrations is often useful for identifying non-site-related chemicals that may be found at or near the site. The use of background values are described in the following text for each matrix evaluated.

Soil:

Nine offsite soil samples (six surface and three subsurface) were collected and analyzed for pesticides/polychlorinated biphenyls, Sevin, Malathion, selected metals (arsenic, cadmium,

chromium, and lead) by EPA method 6010, hexavalent chromium, and total organic halogens (TOX). The presence of pesticides in these samples indicates that these offsite samples are not appropriate to use for background soil concentration comparisons.

An alternate source for appropriate background soil concentration data was not found. The USDA Soil Conservation Service (now referred to as the USDA Natural Resources Conservation Service) was consulted, but could not provide background soil concentrations for Burlington County, New Jersey. Also, no background soil data were available from other Superfund sites within this county.

Due to the above reasons and the fact that additional offsite soil samples will not be collected in order to provide appropriate background concentration data, no background comparisons to site soil concentrations have been made.

2.3.3 Physical and Chemical Properties

The chemicals detected in surface soil, subsurface soil, air, ground water, surface water, and sediment samples collected from the site can be classified into categories according to their similarity in chemical structure and/or physicochemical properties (factors which would influence mobility in the environment). The chemical categories and examples of chemicals detected at the site within each category are listed below:

- Chlorinated aliphatic compounds: methylene chloride, chloroform tetrachloroethene
- Simple aromatic compounds: benzene, ethylbenzene, toluene, xylenes (total)
- Chlorinated aromatic compounds: chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, hexachlorobenzene, 1,2,4-trichlorobenzene
- Ketones: acetone
- Phenolic compounds: phenol, 4-methylphenol
- Phthalate esters: bis(2-ethylhexyl)phthalate, di-n-butylphthalate, diethylphthalate, butylbenzylphthalate
- Amines: N-Nitrosodiphenylamine
- Polycyclic aromatic hydrocarbons: carcinogenic and noncarcinogenic PAHs
- Chlorinated pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, aldrin, endosulfan I
- Inorganics (behaving as cations in water): aluminum, antimony, barium, cadmium, trivalent chromium, copper, iron, lead, manganese, mercury, nickel, zinc
- Inorganics (behaving as anions in water): arsenic, vanadium
- Inorganics (behaving as anions in water): cyanide
- Dioxins: OCDD, HpCDF

The physical and chemical properties that are important in determining a chemical contaminant's persistence and mobility in the environment were evaluated. The main properties that were reviewed were water solubility, K_{oc} (organic carbon partitioning coefficient), K_{ow} (octanol-water partitioning coefficient), volatilization, vapor pressure, vaporization, and Henry's law constant. This information is more difficult to evaluate for the inorganic chemicals because the migration

of inorganics depends upon several site-specific factors such as the following:

- The presence of other cations and anions which can enhance or limit mobility by forming complexes
- pH differences between infiltrating precipitation, soil pore water, and aquifer materials
- the ability of the soil to retain metals through cation or anion exchange
- the presence of oxidizing or reducing agents
- the presence of humic materials or other organic chelating agents

The mobility of metals is therefore greatly dependent upon external factors which are seldom measured and cannot be easily determined based upon chemical-specific properties such as vapor pressure, solubility, and sorption to organic carbon. Moreover, physicochemical properties depend upon the identity of the metal complex which is almost never known (i.e., the analysis provides only information on total metal concentration, not on the metal complex or valence state).

The water solubility of a chemical is a critical property affecting its environmental fate. Chemicals with high water solubility can be rapidly leached from contaminated soil and are generally mobile in the ground water. Solubilities can range from less than one mg/liter to totally miscible with most common organic chemicals falling between one mg/liter to 10^6 mg/liter (Lyman et al., 1982). The solubility of a chemical which is not readily soluble in water can

become enhanced in the presence of other organic solvents which in and of themselves are more soluble in water.

The K_{oc} is used to reflect the potential of a chemical to sorb to the organic matter found in soil. The normal range of K_{oc} is 1 to 10^7, with higher values indicating greater sorption potential and lower values indicting limited retardation of a chemical. The K_{ow} is used to estimate the extent to which a chemical will partition from water into lipophilic parts of organisms (i.e., animal fat). The greater the K_{ow}, the more likely a chemical is to partition to octanol (considered a surrogate for lipids).

Volatilization of a chemical is dependent on its vapor pressure, water solubility, and diffusion coefficients. Vapor pressure is a measure of the volatility of a chemical in its pure state. Vapor pressures typically range from 10^{-3} to 760 mm Hg for liquids, with solids ranging to less than 10^{-10}. Highly water soluble compounds generally have lower volatilization rates from water unless they also have high vapor pressures. Vaporization is also a major transport process. The rate of vaporization depends on temperature, degree of adsorption, soil properties, and soil water content. Airflow over the evaporating surface also affects the rate of vaporization.

Henry's law constant, which combines vapor pressure with solubility and molecular weight, is more appropriate for estimating releases from water to air than the vapor pressure. Chemicals with Henry's law constants in the range of 10^{-3} atmospheres - meter^3/mole (atm-m^3/mol) and larger can be expected to be readily released to the atmosphere through volatilization. Chemicals

with values ranging from 10^{-3} to 10^{-5} atm-m^3/mol are associated with moderate volatilization, while chemicals with values less than 10^{-5} atm-m^3/mol will only volatilize to a limited extent.

2.4 Evaluation of Tentatively Identified Compounds (TICS)

The RAGS document (USEPA, 1989a) specifies that both the identity and reported concentration of a TIC are questionable. As part of field activities related to the Pulverizing Services site SI, the USEPA's TCL and TAL analytical list of chemicals were analyzed for. Chemicals on the TCL and TAL, however, may be a limited subset of the chemicals which may actually be encountered at the operable unit. The analysis of VOCs and SVOCs may indicate the presence of additional organics not on the TCL. These additional chemicals appear as peaks on a chromatogram. A chromatogram is a paper representation of the response of the analytical instrument to the presence of a chemical. The laboratory attempts to identify the thirty highest peaks (ten VOCs and twenty SVOCs) using computerized searches of a library containing mass spectra (essentially fingerprints for particular chemicals). When the mass spectra match to a certain degree, the chemical or chemical class is named; however, the assigned identity is highly uncertain in most cases. These chemicals are called tentatively identified compounds or TICs (USEPA, 1989a). For this site, toxicity values were identified for numerous TICs detected in soil, ground water, surface water, and sediment matrices. Using the FORM Is, (data forms used for tabulating and reporting sample analysis results for target compounds), the maximum detected concentrations of the individual TICs having established toxicity values were obtained and used in the chemical concentration-toxicity screens. TICs were selected as chemicals of potential

concern in the surface water matrix only and have been quantitatively evaluated as appropriate.

2.5 Selected Chemicals of Potential Concern

Using the criteria discussed in Section 2.3, chemicals of potential concern were selected for surface soil, subsurface soil, ground water, surface water, and sediment. Table 2-24 presents the chemicals selected for quantitative evaluation in the risk assessment.

TABLE 2-24

PULVERIZING SERVICES SITE
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN IN SITE MATRICES BY AREA OF CONCERN

SURFACE SOIL				SUBSURFACE SOIL		GROUND WATER	SURFACE WATER		SEDIMENT	
AREA A	**AREA B**	**AREA C**	**AREA A AND AREA C (COMBINED)**	**AREA A**	**AREA B**	**ON-SITE**	**DRAINAGE FROM AREA A-C**	**DRAINAGE FROM AREA A-B**	**DRAINAGE FROM AREA A-C**	**DRAINAGE FROM AREA A-B**
VOCs:	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*	*VOCs:*
None Selected	None Selected	None Selected	None Selected	None Selected	None Selected	None Selected	None Selected	None Selected	None Selected	None Selected
SVOCs:	*SVOCs:*	*SVOCs:*	*SVOCs:*	*SVOCs:*	*SVOCs:*	*SVOCs:*	*SVOCS:*	*SVOCS:*	*SVOCs:*	*SVOCs:*
None Selected	Benzo(a)pyrene Benzo(b)-fluoranthene	None Selected	None Selected	None Selected	None Selected	None Selected	None Selected	Ethylene thiourea (TIC)	None Selected	Benzo(a)anthracene Benzo(b)fluoranthene Benzo(a)pyrene
Pesticides:	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*	*Pesticides:*
Aldrin Dieldrin 4,4'-DDT	4,4'-DDD 4,4'-DDE 4,4'-DDT	4,4'-DDT	Aldrin Dieldrin 4,4'-DDT	alpha-BHC Aldrin Dieldrin 4,4'-DDT	4,4'-DDE 4,4'-DDT	alpha-BHC Dieldrin Lindane (Total)	alpha-BHC beta-BHC Dieldrin Lindane (Total) 4,4'-DDT Methoxychlor	alpha-BHC Dieldrin 4,4'-DDD	alpha-BHC Dieldrin 4,4'-DDD 4,4'-DDE 4,4'-DDT Methoxychlor	alpha-BHC Dieldrin 4,4'-DDT Methoxychlor Rotenone
Fungicide:	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*	*Fungicide:*
Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	PCNB
Dioxin:	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*	*Dioxin:*
Not Selected	OCDD*	OCDD*	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected	Not Selected
Inorganics:	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*	*Inorganics:*
None Selected	Arsenic Manganese	Arsenic Beryllium Manganese Vanadium	None Selected	Arsenic Manganese	Arsenic	Arsenic Cadmium	Arsenic Cadmium	Arsenic Chromium III Chromium VI	Arsenic Cadmium Manganese	Arsenic Cadmium

* The 2,3,7,8-TCDD toxicity equivalency factor was used to evaluate the risk associated with OCDD.

3.0 EXPOSURE ASSESSMENT

This section of the risk assessment presents the approach used for identifying the potential human exposure pathways at the site for present and potential future land use scenarios. The exposure pathways identified in this section are later combined (Section 5.0) with chemical-specific toxicity values to characterize potential carcinogenic risks and noncarcinogenic health effects. All plausible exposures to receptor populations (e.g., residents and site workers) associated with current and potential future site conditions have been evaluated. Present conditions are as they exist today and future conditions are based on potential future land uses of the site, assuming no additional remediation has occurred.

For both present and potential future site conditions, exposure scenarios which identify plausible routes of exposure to site-related chemical contaminants were developed. Exposure pathways were identified by assessing the various ways in which people living (i.e., future residents) or working at the site could potentially be exposed to chemicals originating from the site. The exposure point concentration of each chemical to which a person may be exposed via each pathway was estimated using the 95 percent UCL calculation or maximum detected concentration, as appropriate. From the estimated exposure point concentrations, potential chemical intakes were calculated in terms of the mass of a substance ingested, dermally contacted, and/or inhaled per unit body weight per unit time, expressed as milligrams of a chemical per kilogram of body weight per day. Variables such as contact rate, exposure frequency, and exposure duration were considered in the calculation of the chemical intakes.

3.1 Potential Release and Transport Mechanisms

Chemical contaminants present in waste materials and contaminated source media may migrate through a number of release and transport mechanisms. In general, potential release and transport mechanisms may include:

- The adsorption of chemical contaminants onto soil and sediment,
- The leaching of chemical contaminants from soil into underlying ground water due to infiltration of precipitation,
- The migration and discharge of chemical contaminants present in the ground water and leachate to surface water and other receptors,
- The migration of chemical contaminants in soil via surface runoff and windblown dusts,
- The volatilization of chemical contaminants present in soil, ground water, and surface water into the ambient air,
- The generation of fugitive dust from contaminated soil into the ambient air via wind erosion or mechanical disturbances of soil,
- The transport of volatiles/chemicals and dust to ambient air downwind locations, and
- The uptake of chemical contaminants present in soil, surface water, and sediment by biota.

3.2 Identification of Exposure Pathways

The objective of the exposure assessment is to estimate the type and magnitude of exposures to chemicals of potential concern at or migrating from the site. The results of the exposure

assessment are then combined with chemical-specific toxicity data to determine site-specific carcinogenic risks and noncarcinogenic hazards.

In accordance with RAGS (USEPA, 1989a), when determining the exposure pathways for a site, two steps are followed. The initial step consists of characterizing the exposure setting. This step includes consideration of the physical characteristics of the site and the human receptors at or in the vicinity of the site (i.e., residents). Site characteristics, which are noted during the site visit(s), may include climate, soil type (e.g., sandy), vegetation (i.e., grassy or bare), presence of paved surfaces, and presence of surface water. Potential human receptors such as on-site residents or workers may be observed with respect to activity patterns, presence of sensitive receptors (e.g., children, occupationally exposed individuals), and location. Potentially exposed off-site receptors (i.e., local residents - trespassers, downgradient public water supply consumers, downwind receptors) must also be considered. This step must also take into account the presence of potential future receptors under an alternate land use condition (i.e., zoning changes, currently unused water that is of potable quality for future use).

The second step of exposure assessment involves identifying the appropriate exposure pathways for the site. As described in RAGS (USEPA, 1989a), an exposure pathway describes the course a chemical or physical agent takes from the source to the exposed individual. An exposure pathway analysis links the sources, locations, types of environmental releases, and environmental fate with receptor locations and activity patterns. An exposure pathway generally consists of four elements:

- a source and mechanism of release,
- a transport medium,
- an exposure point (point of potential contact with a contaminated medium), and
- an exposure route (e.g., ingestion) at the exposure point.

The following presents the basic analytical process for identifying and selecting exposure pathways in the risk assessment. An environmental medium contaminated by a previous release can be a contaminant source for other media. The identification of potential release mechanisms and receiving media may be determined utilizing site histories and data from existing reports. Examples of typical release sources, mechanisms of release, and receiving media include the following:

- volatilization of chemicals from surface soil, surface water, lagoons or spills into the air; and fugitive dust generation from contaminated surface soil or waste piles,
- surface runoff from contaminated surface soil into surface water; episodic overland flow resulting from lagoon overflow, spills or leaking containers; and seepage of contaminated ground water into surface water,
- leaching from surface or buried wastes into soil; surface runoff from contaminated surface soil; episodic overland flow resulting from lagoon overflow, spills or leaking containers; and fugitive dust generation/deposition from contaminated surface soil or waste piles,
- leaching from surface or buried wastes and contaminated soil into ground water,
- leaching from surface or buried wastes and contaminated soil into sediment; surface runoff and episodic overland flow from surface wastes and contaminated surface soil; and seepage of contaminated ground water into sediment, and
- direct uptake of contaminated air, soil, ground water, surface water, sediment or other biota by biota.

The fate and transport of the chemicals from release media are then considered in order to identify media that are receiving or may receive site-related chemicals. Points of potential contact with chemically contaminated media (or sources) by human receptors are then considered. After exposure points are identified, potential exposure routes (i.e., ingestion, dermal contact, inhalation) may be selected.

By integrating the information presented above, complete and potentially complete exposure pathways at a site may be retained for quantitative evaluation in the risk assessment or eliminated from further analysis.

3.2.1 Present - Use Scenarios

Since residents currently live in the vicinity of the Pulverizing Services site, numerous potential exposure scenarios and human receptors were selected for quantitative evaluation in this risk assessment. Table 3-1 presents the scenarios and receptors considered for analysis with a yes next to those selected and justifications for the pathways' elimination from or retention for quantitative analysis. Justifications are based on visual observations made during the June 23, 1994 site visit, conversations with the USEPA, and a review of the sample data for each area or matrix.

Surface Soil: During the site visits, residential areas consisting of private residences were observed at the western and southern edges of the site. For investigative purposes, the site was

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
PRESENT - USE SCENARIOS:				
Surface Soil	Area Residents/Trespassers (12 - 17 years old) Area A	Ingestion	Yes	Residents of the residential area at the western edge of this area may come into direct contact with surface soil in Area A. During the initial site visit, evidence of trespassing in this Area was observed (e.g., open building doors). The dermal contact route of exposure could not be quantitatively addressed since the selected chemicals of potential concern do not have established dermal contact absorption values. Exposure from the inhalation of particulates may occur since several small areas of ground have no existing vegetation.
		Dermal Contact*	No	
		Inhalation of Particulates	Yes	
	Area Residents/Trespassers (12 - 17 years old) Area B	Ingestion	Yes	Residents of the residential area at the western and southern edges of the site may come into direct contact with surface soil in Area B, as only a chain link fence surrounds the area and the back gate has been observed open. Trespasser exposure to suspended surface soil particulates is assumed to be negligible based on the lower frequency of exposure in this area as compared to Area A and the presence of ground cover.
		Dermal Contact*	Yes	
		Inhalation of Particulates	No	
	Area Residents/Trespassers (12 - 17 years old) Area C	Ingestion	Yes	Residents of the residential area at the western edge of Area A may come into direct contact with surface soil in Area C as Area C is not physically separated from Area A and evidence of trespassing exists for Area A. Trespasser exposure to suspended surface soil particulates is assumed to be negligible based on the presence of ground cover.
		Dermal Contact*	Yes	
		Inhalation of Particulates	No	
	Downwind (Offsite) Residents	Ingestion	No	Since no construction work (i.e., excavation activity) is currently in progress at the site, exposure from particulate releases into the ambient air and transport downwind is assumed to be negligible.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Site Workers/Employees (Site-Wide)	Ingestion	No	Since the facility is no longer operational, no site worker/employee exposure is occurring.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Construction Workers (Site-Wide)	Ingestion	No	Since no construction work (i.e., excavation activity) is currently in progress at the site, construction workers are not assumed to be exposed to site surface soil.
		Dermal Contact	No	
		Inhalation of Particulates	No	

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
PRESENT - USE SCENARIOS CONT'D:				
Subsurface Soil	Area Residents/Trespassers (12 - 17 years old) Area A and Area B	Ingestion	No	Since no construction work (i.e., excavation activity) is currently in progress at the site, trespasser exposure to subsurface soil is not assumed to occur.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Downwind (Offsite) Residents	Ingestion	No	Since no construction work (i.e., excavation activity) is currently in progress anywhere on the site, exposure from subsurface soil particulate releases into the ambient air and transport downwind is not assumed to occur.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Site Workers/Employees (Site-Wide)	Ingestion	No	Since the facility is no longer operational, no site worker/employee exposure is assumed to occur.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Construction Workers (Site-Wide)	Ingestion	No	Since no construction work (i.e., excavation activity) is currently in progress at the site, no construction worker exposure to subsurface soil is assumed to occur.
		Dermal Contact	No	
		Inhalation of Particulates	No	
Air	Downwind (Offsite) Residents (Adults and Children)	Inhalation of VOCs	No	Residents living downwind of the site may be exposed to VOCs released into the ambient air and transported downwind; however, this pathway can only be qualitatively addressed with the minimal amount of available data.
	Site Workers/Employees (Site-Wide)	Inhalation of VOCs	No	Since the facility is no longer operational, no site worker/employee exposure to VOCs in air is occurring.
	Construction Workers (Site-Wide)	Inhalation of VOCs	No	Since no construction work (i.e., excavation activity) is currently in progress at the site, no construction worker exposure to VOCs released into the air is assumed to occur.

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
PRESENT - USE SCENARIOS CONT'D:				
Ground Water (Saturated Surficial and Deep Potable Aquifers)	Residents (Adults and Children) (Site-Wide)	Ingestion	No	No residents currently live onsite. Therefore, no residential exposure to onsite ground water is occurring.
		Dermal Contact (Shower) (Adults only)	No	
		Inhalation of VOCs (Shower) (Adults only)	No	
	Site Workers/Employees (Site-Wide)	Ingestion	No	Since the facility is no longer operational, no site worker/employee exposure to ground water is occurring.
		Dermal Contact (Shower)	No	
		Inhalation of VOCs (Shower)	No	
	Construction Workers (Site-Wide)	Ingestion	No	Since no construction work (i.e., excavation activity) is currently in progress at the site, no construction worker exposure to ground water is occurring.
		Dermal Contact (Shower)	No	
		Inhalation of VOCs (Shower)	No	
Surface Water (Drainage ditches in all areas and swampy location of Area B - includes Drainage from Area A through Area C and from Area A through Area B)	Area Residents/Trespassers (12 - 17 years old)	Ingestion	No	Trespassers may dermally contact surface water in the drainage ditches and swampy location while onsite. However, they are not assumed to ingest surface water since it is considered too shallow to support formal recreational activities (i.e., wading, swimming). Since limited contact with surface water is likely to occur, exposure from releases of VOCs into the ambient air is assumed to be negligible.
		Dermal Contact *	Yes	
		Inhalation of VOCs	No	
Sediment (Drainage ditches in all areas, and swampy location of Area B, storm sewer, and trench - includes Drainage from Area A through Area C and from Area A through Area B)	Area Residents/Trespassers (12 - 17 years old)	Ingestion	No	Trespassers may dermally contact sediments in the drainage ditches, trench, storm sewer, and swampy location while onsite. However, they are not assumed to ingest sediment since these areas are considered too shallow to to support formal recreational activities (e.g., wading, swimming). Although the drainage ditches, trench, storm sewer, and swampy location dry out on occasion, exposure to suspended sediment particulates is assumed to be negligible.
		Dermal Contact*	Yes	
		Inhalation of Particulates	No	

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS:				
Surface Soil	Residents (Adults and Children) Areas A and C (Combined)	Ingestion	Yes	If the site is residentially developed in the future, residents may come into direct contact with surface soil in the vicinity of their homes. It was assumed if a neighborhood was to be developed that Areas A and C would be developed together to create a neighborhood rather than separately. The dermal contact route of exposure could not be quantitatively evaluated, however, based on the selected chemicals of potential concern.
		Dermal Contact*	No	
		Inhalation of Particulates	Yes	
	Residents (Adults and Children) Area B	Ingestion	Yes	If the site is residentially developed in the future, residents may come into direct contact with surface soil in the vicinity of their homes. Ground cover is assumed to be absent in the future.
		Dermal Contact*	Yes	
		Inhalation of Particulates	Yes	
	Site Workers/Employees Area A	Ingestion	Yes	If the site is developed for commercial or industrial purposes in the future, site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour). The dermal contact route of exposure could not be quantitatively evaluated, however, based on the selected chemicals of potential concern.
		Dermal Contact*	No	
		Inhalation of Particulates	Yes	
	Site Workers/Employees Area B	Ingestion	Yes	If the site is developed for commercial or industrial purposes in the future, site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour).
		Dermal Contact*	Yes	
		Inhalation of Particulates	Yes	
	Site Workers/Employees Area C	Ingestion	Yes	If the site is developed for residential or commercial purposes in the future, site workers may come into direct contact with surface soil during the course of a normal work day (i.e., outdoor work, lunch hour).
		Dermal Contact*	Yes	
		Inhalation of Particulates	Yes	
	Construction Workers Areas A and C (Combined)	Ingestion	No	Although the site may be developed for residential or commercial purposes in the future, construction worker direct contact with surface soil during the course of a work day (i.e., outdoor work, excavation) is assumed to be negligible as compared to subsurface soil exposure.
		Dermal Contact*	No	
		Inhalation of Particulates	No	
	Construction Workers Area B	Ingestion	No	Although the site may be developed for residential or commercial purposes in the future, construction worker direct contact with surface soil during the course of a work day (i.e., outdoor work, excavation) is assumed to be negligible as compared to subsurface soil exposure.
		Dermal Contact*	No	
		Inhalation of Particulates	No	

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS CONT'D:				
Subsurface Soil	Residents (Adults and Children) Area A	Ingestion	No	During potential future construction work (i.e., excavation activity), residents are assumed to contact a negligible amount of subsurface soil as compared to construction workers.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Residents (Adults and Children) Area B	Ingestion	No	During potential future construction work (i.e., excavation activity), residents are assumed to contact a negligible amount of subsurface soil as compared to construction workers.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Site Workers/Employees Area A	Ingestion	No	During potential future construction work (i.e., excavation activity), site workers, during the course of a normal work day, are assumed to come into direct contact with a negligible amount of subsurface soil as compared to construction workers.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Site Workers/Employees Area B	Ingestion	No	During potential future construction work (i.e., excavation activity), site workers, during the course of a normal work day, are assumed to come into direct contact with a negligible amount of subsurface soil as compared to construction workers.
		Dermal Contact	No	
		Inhalation of Particulates	No	
	Construction Workers Area A	Ingestion	Yes	During potential future construction work (i.e., excavation activity), construction workers may come into direct contact with exposed subsurface soil particulates as a result of mechanical disturbances. The dermal contact route of exposure could not be quantitatively evaluated since the selected chemicals of potential concern do not have established dermal contact absorption values. Since no VOCS were selected as chemicals c potential concern in subsurface soil, the inhalation of VOCs pathway was not selected for further evaluation.
		Dermal Contact*	No	
		Inhalation of Particulates	Yes	
		Inhalation of VOCs	No	
	Construction Workers Area B	Ingestion	Yes	During potential future construction work (i.e., excavation activity), construction workers may come into direct contact with exposed subsurface soil particulates as a result of mechanical disturbances. The dermal contact route of exposure could not be quantitatively evaluated since the selected chemicals of potential concern do not have established dermal contact absorption values. Since no VOCs were selected as selected as chemicals of potential concern in subsurface soil, the inhalation of VOCs pathway was not selected for further evaluation.
		Dermal Contact*	No	
		Inhalation of Particulates	Yes	
		Inhalation of VOCs	No	

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS CONT'D:				
Air	Residents (Adults and Children) (Site-Wide)	Inhalation of VOCs	No	If the site is residentially developed in the future, residents may be exposed to VOCs released into the ambient air; however, this pathway can only be qualitatively addressed due to the minimal amount of available data.
	Site Workers/Employees (Site-Wide)	Inhalation of VOCs	No	If the site is developed for commercial or industrial purposes in the future, site workers/employees, during the course of a normal work day, may be exposed to VOCs released into the ambient air; however, this pathway can only be qualitatively addressed due to the minimal amount of available data.
	Construction Workers (Site-Wide)	Inhalation of VOCs	No	If construction work is performed at the site in the future (i.e., commercial or industrial development), construction workers may be exposed to VOCs released into the ambient air; however, this pathway can only be qualitatively addressed due to the minimal amount of available data.
Ground Water (Saturated Surficial Aquifer)	Site Residents (Adults and Children) (Site-Wide)	Ingestion	Yes	The potential exists, if the site is residentially developed in the future, for site residents to obtain their potable water from wells installed into the saturated surficial aquifer beneath the site. Since no VOCs were selected as chemicals of potential concern in ground water, the shower model was not run in the risk assessment. For the dermal contact while showering pathway, however, pesticides and inorganics are quantitatively evaluated for adults.
		Dermal Contact (Shower) (Adults only)	Yes	
		Inhalation of VOCs (Shower) (Adults only)	No	
	Site Workers/Employees (Site-Wide)	Ingestion	Yes	The potential exists, in the future, for wells to be installed into the saturated surficial aquifer beneath the site. Potential future site workers/employees may ingest ground water from the site; however, they are not assumed to shower on-site.
		Dermal Contact (Shower)	No	
		Inhalation of VOCs (Shower)	No	
	Construction Workers (Site-Wide)	Ingestion	No	Although potential exists, in the future, for wells to be installed into the saturated surficial aquifer beneath the site, potential future construction workers are not expected to ingest ground water from the site or to shower onsite. In addition, construction workers would be protected under the residential exposure scenario.
		Dermal Contact (Shower)	No	
		Inhalation of VOCs (Shower)	No	
Ground Water (Deep Potable Aquifer)	Site Residents (Adults and Children) (Site-Wide)	Ingestion	No	The potential exists, if the site is residentially developed in the future, for site residents to obtain their potable water from wells installed into the deep potable aquifer beneath the site; however, this pathway can only be qualitatively addressed due to the minimal amount of available data.
		Dermal Contact (Shower) (Adults only)	No	
		Inhalation of VOCs (Shower) (Adults only)	No	
	Site Workers/Employees (Site-Wide)	Ingestion	No	The potential exists, in the future, for wells to be installed into the deep potable aquifer beneath the site. Potential future site workers may ingest ground water from the site; however, this pathway can only be qualitatively addressed due to the minimal amount of available data.
		Dermal Contact (Shower)	No	
		Inhalation of VOCs (Shower)	No	

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TABLE 3-1

PULVERIZING SERVICES SITE
POTENTIAL EXPOSURE PATHWAYS

Matrix	Receptor Population(s)	Exposure Route(s)	Retained for Quantitative Analysis	Justification
FUTURE - USE SCENARIOS CONT'D:				
Ground Water (Deep Potable Aquifer) (Cont'd)	Construction Workers (Site-Wide)	Ingestion Dermal Contact (Shower) Inhalation of VOCs (Shower)	No No No	The potential exists, in the future, for wells to be installed into the deep potable aquifer beneath the site. Potential future construction workers may ingest ground water from the site; however, this pathway can only be qualitatively be addressed due to the minimal amount of available data.
Surface Water (Drainage ditches in all areas and swampy location of Area B - includes Drainage from Area A through Area C and from Area A through Area B)	Residents (Adults and Children)	Ingestion Dermal Contact Inhalation of VOCs	No Yes No	If the site is residentially developed in the future, residents may dermally contact surface water in the vicinity of their homes. Since surface water in the ditches and swampy location is too shallow to support formal recreational activities (e.g., wading, swimming), ingestion is not likely to occur. As limited contact with surface water is likely and no VOCs were selected as chemicals of potential concern,inhalation exposure from VOC release into the ambient air is assumed to be negligible.
Sediment (Drainage ditches, swampy location of Area B, storm sewer, and trench - includes Drainage from Area A through Area C and from Area A through Area B)	Residents (Adults and Children)	Ingestion Dermal Contact* Inhalation of Particulates	No Yes No	If the site is residentially developed in the future, residents may dermally contact sediment in the storm sewer and swampy location. However, they are not assumed to ingest sediment since these areas are considered too shallow to support formal recreational activities (e.g., wading, swimming). Although the drainage ditches, trench, storm sewer, and swampy location on occasion dry out, exposure to suspended sediment particulates is assumed to be negligible.

* For this site, the dermal contact pathway can only be quantitatively evaluated for dioxin and cadmium as only these chemicals have established dermal absorption factors (dioxin = 3% and cadmium = 1%).

divided into three areas, Area A, Area B, and Area C, based on site operations and physical location. Historic information suggests that Area A was the main industrial area of the site where most activity occurred while the facility was in operation. Analytical data show that this area (Area A) is more chemically contaminated than Areas B and C. Based on this information, the three areas have been evaluated separately under the present use scenario.

Area residents/trespassers may inadvertently ingest, dermally contact, and/or inhale surface soil in Area A, B or C during recreational (e.g., trespassing) activities. Evidence of trespassing in Area A was observed during the site visit (e.g., open building doors). Area B may be accessible even though it is surrounded by a chain link fence, since the back gate was observed to be open during the site visit. Since Area C is not physically separated from Area A, and evidence of trespassing exists in Area A, this area may also be accessed by area residents/trespassers. Although dermal contact with surface soil may occur in all three areas, this route of exposure could not be quantitatively evaluated in Area A since no soil dermal contact absorption factors are established for the selected chemicals of concern (aldrin, dieldrin, and 4,4-DDT). The inhalation of suspended surface soil particulates was selected for quantitative evaluation for Area A only, as only this area has exposed ground (i.e., no vegetation exists).

Downwind residents located offsite are not assumed to come into direct contact with site surface soil as no construction work resulting in mechanical disturbances is currently in progress.

Site workers/employees (site-wide) were not selected for quantitative evaluation of surface soil

since the site is no longer an operating facility.

Construction workers (site-wide) were not selected for quantitative evaluation of surface soil since no construction work is currently in progress at the site (Area A, B or C).

Subsurface Soil: Based on visual observations made during the site visit, no construction work involving excavation activity is currently in progress at the site. Therefore, no exposure to subsurface soil by any of the potential receptors (area residents/trespassers, downwind (offsite) residents, site workers/employees (site-wide), and construction workers (site-wide)) is occurring at present.

Air: Since only one air sample was collected at the site, downwind (offsite) residents, site workers/employees (site-wide), and construction workers (site-wide) cannot be quantitatively evaluated for inhalation exposure to VOCs in air.

In addition, since the site is no longer an operating facility, site workers/employees (site-wide) were not selected for quantitative evaluation of VOCs in air.

Construction workers (site-wide) were also not selected for quantitative evaluation of VOCs in air since no construction work is currently in progress at the site.

Ground Water: No present-use ground water exposure scenarios were selected for quantitative

evaluation in the risk assessment as the exposure pathway is incomplete. Residents do not currently live at the site and since the facility is no longer operational, site workers/employees are not present. No construction work is currently in progress at the site; therefore, no construction workers are present.

Surface Water: Based on visual observations made during the site visit, surface water in the Drainage Ditches in all areas and swampy location of Area B (includes Drainage from Area A through Area C and from Area A through Area B), is too shallow to support formal recreational activities such as swimming and wading. Area residents/trespassers may dermally contact surface water in the ditches and swampy location while onsite; however, they are expected to ingest a negligible amount of surface water and to inhale a negligible amount of VOCs released from surface water into the ambient air. It should be noted that no VOCs were selected as chemicals of potential concern.

Sediment: The surface water in the Drainage Ditches in all areas and swampy location of Area B (includes Drainage from Area A through Area C from Area A through Area B), is too shallow to support formal recreational activities. No surface water samples were collected from the storm sewer and trench as they were dry at the time of sampling. Area residents/trespassers may dermally contact sediment in any of these areas while onsite; however, they are expected to ingest a negligible amount of sediment. Although these areas dry out on occasion, the amount of sediment particulates released into the ambient air is assumed to be very low and the amount inhaled negligible.

3.2.2 Future - Use Scenarios

The potential exists, in the future, for residential or commercial development of the Pulverizing Services site. Based on visual observations made during the site visit, historical information, discussions with the USEPA, and professional judgement, potential future-use exposure scenarios and human receptors were selected for quantitative evaluation. Table 3-1 presents the scenarios and receptors considered for analysis with a "yes" next to those selected and justifications for the pathways' elimination from or retention for quantitative analysis.

Surface Soil: As discussed for the present-use scenario, for investigative purposes the site has been divided into three main areas designated as Areas A, B, and C. If either of these areas is residentially developed in the future, the potential would exist for residents (adults and children) to come into direct contact with surface soil. Since Areas A and C are contiguous and no physical separation (i.e., barrier) exists, it is assumed that these areas would be developed together (at the same time), but separately from Area B. It was assumed based on zoning that Areas A and C would not be developed differently under this scenario. It was assumed that the 16 acres would be developed to create a neighborhood. Although dermal contact with surface soil may occur in all three areas, this route of exposure could not be quantitatively evaluated in Areas A and C (Combined) since no soil dermal contact absorption values are established for the selected chemicals of potential concern (aldrin, dieldrin and 4,4'-DDT).

If the site is commercially developed in the future, site workers/employees may come into direct

contact with surface soil while performing job-related activities (i.e., outdoor work) and/or during lunch hour. Site workers/employees are evaluated for Areas A, B, and C separately, since these areas may be purchased and developed separately and at different times, and may serve different functions in the future. The dermal contact route of exposure could not be quantitatively evaluated in Area A since no soil dermal contact absorption values are established for the selected chemicals of potential concern (aldrin, dieldrin, and 4,4'-DDT).

Although the site may be residentially or commercially developed in the future, construction worker direct contact with surface soil during the course of a normal work day (i.e., outdoor work including excavation) is assumed to be negligible as compared to subsurface soil exposure.

Subsurface Soil: If the site is developed for residential or commercial purposes in the future, construction workers would be expected to come into direct contact with subsurface soil (i.e., during excavation activities) as a result of mechanical disturbances. The dermal contact with subsurface soil route of exposure could not be quantitatively evaluated since no soil dermal contact absorption values are established for the selected chemicals of potential concern (alpha-BHC, aldrin, dieldrin, 4,4'-DDT, DDE, arsenic and manganese). In addition, the inhalation of VOCs pathway was not selected from quantitative evaluation as no VOCs were selected as chemicals of potential concern. It is assumed that Areas A and B would be developed separately as discussed for surface soil. It should be noted that no subsurface soil data are available for Area C although screening data were collected. During potential future construction work involving excavation activity, residents and site workers/employees are assumed to come into direct contact with a

negligible amount of subsurface soil as compared to construction workers.

Air: Since only one air sample was collected at the site, site-wide residents, site workers/employees, and construction workers cannot be quantitatively evaluated for inhalation exposure to VOCs in air.

Ground Water: If the site is residentially developed in the future, it is possible that new residential wells may be installed into the chemically contaminated saturated surficial aquifer beneath the site. Residents are expected to ingest the contaminated ground water (e.g., during cooking). Since no VOCs were selected as chemicals of potential concern, the shower model was not run. However, the pesticides and inorganics selected as chemicals of potential concern were quantitatively evaluated for the dermal contact while showering pathway for adults. The deep potable aquifer could not be quantitatively evaluated because there is only one deep well (the production well) at the site. However, the deep potable aquifer is isolated from the site by approximately two hundred feet of clay and is therefore considered to be unaffected by site contaminants. This view is further supported by the results of the sample taken in the deep well.

If the site is developed for commercial or industrial purposes in the future, site workers/employees may ingest ground water from the saturated surficial aquifer. Site workers/employees, however, are not assumed to shower onsite.

Construction workers are not expected to ingest ground water from the saturated surficial aquifer while onsite, nor are they expected to shower onsite. Since the residential ground water exposure

scenario is much more conservative than that of the construction worker, the construction worker exposure to ground water was not evaluated for this site.

Surface Water: It is assumed in the future that surface water in the Drainage Ditches in all areas and swampy location of Area B will remain too shallow to support formal recreational activities such as swimming and wading. Future residents may dermally contact this surface water in the vicinity of their homes but are not assumed to ingest surface water. As limited receptor contact with surface water is assumed to occur and no VOCs were selected as chemicals of potential concern, exposure via the inhalation of VOCs released from surface water into the ambient air is assumed to be negligible.

Sediment: The Drainage Ditches and swampy location of Area B is assumed to remain too shallow to support formal recreational activities in the future. Future residents may dermally contact sediment in these areas; however, they are expected to ingest a negligible amount of sediment. Although these areas dry out on occasion, the amount of sediment particulates released into the ambient air is assumed to be very low and the amount inhaled negligible.

3.3 Exposure Point Concentrations

Concentrations at potential exposure points (any point of potential contact with a contaminated medium) were developed for each chemical in surface soil, subsurface soil, ground water, surface water, and sediment for use in calculation of the chronic or subchronic daily intake for each

chemical of potential concern. Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is considered a reasonable estimate of the concentration likely to be contacted over time, since long-term contact with the maximum concentration is not a reasonable assumption.

Due to the uncertainty associated with any estimate of exposure concentration, the 95 percent UCL on the arithmetic mean is used for this variable. If there is a large variability in measured or modeled concentrations, the 95 percent UCL may exceed the maximum measured or modeled values, in which case, the maximum detected or modeled value is used. The formula used to calculate the 95 percent UCL for a lognormal distribution is as follows:

$$UCL = e^{(\bar{x} + 0.5s2 + sH/\sqrt{n-1})}$$

Where:

UCL	=	upper confidence limit
e	=	constant (base of the natural log, equal to 2.718)
x	=	mean of the transformed data
s	=	standard deviation of the transformed data
H	=	H-statistic (i.e., from table published in Gilbert, 1987)
n	=	number of samples

In calculating this value, non-detects were accounted for by using one-half the sample quantitation limit (SQL). If one-half the SQL exceeded the maximum detection, the maximum detection was utilized as the default value. Appendix A presents the calculated 95 percent UCL concentrations used to estimate carcinogenic risks and noncarcinogenic hazards.

3.4 Calculation of Chronic and Subchronic Daily Intakes

To quantitatively assess the potential carcinogenic risks and health hazards to human populations based on the present-use and potential future-use scenarios discussed in Section 3.2, daily intakes were calculated. These daily intakes were evaluated for both chronic and subchronic exposures (USEPA, 1989a). For the chronic and subchronic daily intakes, intakes are averaged over a lifetime for carcinogenic chemicals and over the period of exposure for noncarcinogens. The daily intake is expressed in terms of the mass of the chemical contaminant per unit of body weight over the averaging time (mg chemical/kg body weight-day).

Equations presented and described in RAGS (USEPA, 1989a) were used to estimate daily intakes for ingestion, dermal contact, and inhalation exposures. The inhalation of suspended soil particulates daily intake was calculated based on the equation presented in USEPA (1989b). These equations are presented in Tables 3-2 through 3-7 and also appear at the top of the appropriate spreadsheets for clarity.

3.5 Exposure Assumptions

All exposure parameters selected for use in the chronic and subchronic daily intake calculations are presented in Table 3-8. The following sections describe the reasoning behind their selection

TABLE 3-2

PULVERIZING SERVICES SITE

INGESTION OF CHEMICALS IN SOIL

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil (mg/kg)
IR	=	Ingestion Rate (mg soil/day)
CF	=	Conversion Factor (10^{-6} kg/mg)
FI	=	Fraction Ingested from Contaminated Source (unitless)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged - days)

TABLE 3-3

PULVERIZING SERVICES SITE

DERMAL CONTACT WITH CHEMICALS IN SURFACE SOIL AND SEDIMENT

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil (mg/kg)
CF	=	Conversion Factor (10^{-6} kg/mg)
SA	=	Skin Surface Area Available for Contact (cm^2/event)
AF	=	Soil to Skin Adherence Factor (mg/cm^2)
ABS	=	Absorption Factor (unitless)
EF	=	Exposure Frequency (events/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged - days)

TABLE 3-4

PULVERIZING SERVICES SITE

INHALATION OF INDOOR AND OUTDOOR SOIL PARTICULATES

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CS \times SSC \times RF \times IR \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil (mg/kg)
SSC	=	Suspended Soil Concentration (mg/m^3)
RF	=	Respirable Fraction (unitless)
IR	=	Inhalation Rate (m^3/hour)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
CF	=	Conversion Factor (10^{-6} kg/mg)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged - days)

TABLE 3-5

PULVERIZING SERVICES SITE

INGESTION OF CHEMICALS IN DRINKING WATER

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical Concentration in Water (mg/liter)
IR	=	Ingestion Rate (liters/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged - days)

TABLE 3-6

PULVERIZING SERVICES SITE
DERMAL CONTACT WITH CHEMICALS IN GROUND WATER
WHILE SHOWERING

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

CW	=	Chemical Concentration in Water (mg/liter)
SA	=	Skin Surface Area Available for Contact (cm^2)
PC	=	Chemical-Specific Dermal Permeability Constant (cm/hr)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
CF	=	Volumetric Conversion Factor for Water (1 liter/1000 cm^3)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged - days)

TABLE 3-7

PULVERIZING SERVICES SITE

DERMAL CONTACT WITH CHEMICALS IN SURFACE WATER

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

Where:

CW	=	Chemical Concentration in Water (mg/liter)
SA	=	Skin Surface Area Available for Contact (cm^2)
PC	=	Chemical-specific Dermal Permeability Constant (cm/hr)
ET	=	Exposure Time (hours/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
CF	=	Volumetric Conversion Factor for Water (1 liter/1,000 cm^3)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged - days)

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TABLE 3-8

PULVERIZING SERVICES SITE
VARIABLES USED FOR CHRONIC AND SUBCHRONIC DAILY INTAKE CALCULATIONS

		CONCENTRATIONS			CONTACT PARAMETERS							TIME VARIABLES					
Matrices and Receptor Populations	Exposure Route	CW (mg/l)	CA/SSC (mg/m3)	CS (mg/kg)	SA (cm2/event)	PC (cm/hr)	IR (1) (variable)	RF (unitless)	AF (mg/cm2)	ABS (unitless)	FI (unitless)	ET (hrs/day)	EF (days/yr)	ED (yrs)	AT (2) (years)	CF (3) (variable)	BW (kg)
Surface Soil																	
Area Residents/Trespassers	Ingestion	-	-	SI Data	-	-	100 mg/day	-	-	-	1	-	78	6	70(6)	1E-6 kg/mg	55
Area A, Area B, and Area C	Dermal Contact	-	-	SI Data	1,540	-	-	-	1	(4)	-	-	78 events/yr	6	70(6)	1E-6 kg/mg	55
(12-17 years old)	Inhalation of Particulates	-	0.035	SI Data	-	-	0.83 m3/hr	0.5	-	-	-	2	78	6	70(6)	1E-6 kg/mg	55
Residents (Areas A and C - Combined, Area B)																	
Adults	Ingestion	-	-	SI Data	-	-	100 mg/day	-	-	-	1	-	350	24	70(24)	1E-6 kg/mg	70
Children (0-6 years old)	Ingestion	-	-	SI Data	-	-	200 mg/day	-	-	-	1	-	350	6	70(6)	1E-6 kg/mg	15
Adults	Dermal Contact	-	-	SI Data	1,920	-	-	-	1	(4)	-	-	350 events/yr	24	70(24)	1E-6 kg/mg	70
Children (0-6 years old)	Dermal Contact	-	-	SI Data	480	-	-	-	1	(4)	-	-	350 events/yr	6	70(6)	1E-6 kg/mg	15
Adults	Inhalation of Particulates	-	0.035	SI Data	-	-	0.83 m3/hr	0.5	-	-	-	18	350	24	70(24)	1E-6 kg/mg	70
Children (0-6 years old)	Inhalation of Particulates	-	0.035	SI Data	-	-	0.6 m3/hr	0.5	-	-	-	18	350	6	70(6)	1E-6 kg/mg	15
Site Workers/Employees	Ingestion	-	-	SI Data	-	-	50 mg/day	-	-	-	1	-	250	25	70(25)	1E-6 kg/mg	70
Area A, Area B, and Area C	Dermal Contact	-	-	SI Data	795	-	-	-	1	(4)	-	-	250 events/yr	25	70(25)	1E-6 kg/mg	70
Adults	Inhalation of Particulates	-	0.035	SI Data	-	-	0.83 m3/hr	0.5	-	-	-	8	250	25	70(25)	1E-6 kg/mg	70
Subsurface Soil																	
Construction Workers (Area A and Area B)	Ingestion	-	-	SI Data	-	-	480 mg/day	-	-	-	1	-	65	1	70(1)	1E-6 kg/mg	70
Adults	Inhalation of Particulates	-	0.035	SI Data	-	-	0.83 m3/hr	0.5	-	-	-	8	65	1	70(1)	1E-6 kg/mg	70
Ground Water (Saturated Surficial Aquifer)																	
Residents																	
Adults	Ingestion	SI Data	-	-	-	-	2 l/day	-	-	-	-	-	350	24	70(24)	-	70
Children (0-6 years old)	Ingestion	SI Data	-	-	-	-	1 l/day	-	-	-	-	-	350	6	70(6)	-	15
Adults	Dermal Contact	SI Data	-	-	18,150 cm2	(5)	-	-	-	-	-	0.5	350	24	70(24)	1E-3 l/cm3	70

TABLE 3-8 (Cont'd)

PULVERIZING SERVICES SITE
VARIABLES USED FOR CHRONIC AND SUBCHRONIC DAILY INTAKE CALCULATIONS

		CONCENTRATIONS			CONTACT PARAMETERS							TIME VARIABLES					
Matrices and Receptor Populations	Exposure Route	CW (mg/l)	CA/SSC (mg/m3)	CS (mg/kg)	SA (cm2/event)	PC (cm/hr)	IR (1) (variable)	RF (unitless)	AF (mg/cm2)	ABS (unitless)	FI (unitless)	ET (hrs/day)	EF (days/yr)	ED (yrs)	AT (2) (years)	CF (3) (variable)	BW (kg)
Ground Water, Continued (Saturated Surficial Aquifer)																	
Site Workers/Employees																	
Adults	Ingestion	SI Data	-	-	-	-	1 l/day	-	-	-	-	-	250	25	70(25)	-	70
Surface Water																	
Area Residents (Trespassers)																	
Children (12-17 years old)	Dermal Contact	SI Data	-	-	1,470 cm2	(5)	-	-	-	-	-	0.5	26	6	70(6)	1E-3 l/cm3	55
Residents																	
Adults	Dermal Contact	SI Data	-	-	1,840 cm2	(5)	-	-	-	-	-	0.5	12	24	70(24)	1E-3 l/cm3	70
Children (12-17 years old)	Dermal Contact	SI Data	-	-	1,470 cm2	(5)	-	-	-	-	-	0.5	26	6	70(6)	1E-3 l/cm3	55
Sediment																	
Area Residents (Trespassers)																	
Children (12-17 years old)	Dermal Contact	-	-	SI Data	1,470	-	-	-	1	(4)	-	-	26 events/yr	6	70(6)	1E-6 kg/mg	55
Residents																	
Adults	Dermal Contact	-	-	SI Data	1,840	-	-	-	1	(4)	-	-	12 events/yr	24	70(24)	1E-6 kg/mg	70
Children (12-17 years old)	Dermal Contact	-	-	SI Data	1,470	-	-	-	1	(4)	-	-	26 events/yr	6	70(6)	1E-6 kg/mg	55

NOTES:

(1) Ingestion or inhalation rate.

(2) The averaging time (AT) is 70 years for carcinogens, 24 years for noncarcinogens for adult residents, 25 years for noncarcinogens for site workers, 6 years for noncarcinogens for children, and 1 year for subsurface soil construction worker exposures (multiplied by 365 days).

(3) Conversion factor (CF) is 1E-6 kg/mg or 1E-3 l/cm3.

(4) Soil and sediment dermal contact absorption factors (ABS) are established for dioxin (3%) and cadmium (1%) only. All other chemicals detected at the site can only be qualitatively evaluated for dermal contact exposure.

(5) This value is the default value for water when no chemical-specific values are available.

Other Abbreviations:

CW = Chemical concentration in water
CA = Chemical concentration in air
SSC = Suspended soil concentration
CS = Chemical concentration in soil or sediment
SA = Skin surface area available for dermal contact
PC= Chemical-specific dermal permeability constant
RF= Respirable Fraction
AF = Soil-to-skin adherence factor
FI = Fraction ingested from contaminant source

ET = Exposure Time
EF = Exposure Frequency
ED = Exposure Duration
BW = Body Weight

and the sources from which the values were obtained. Daily intakes were calculated for area residents/trespassers, residents (adults and children), site workers/employees, and construction workers. For all receptor populations, the chemical concentrations in the various matrices were based on actual site data from which 95 percent UCL values were calculated. In cases where the 95 percent UCL exceeded the maximum detected site concentration, the maximum site detection was used in the daily intake calculation.

3.5.1 Surface Soil

Area Residents/Trespassers: For present child area residents trespassing in Areas A, B, and C, site surface soil data were used to calculate chemical concentrations for the intake equations.

For present 12-17 year old area residents/trespassers, a daily soil ingestion rate (IR) of 100 mg/day was assumed (USEPA, 1991a). The fraction ingested (FI) from contaminated surface soil was conservatively assumed to be 1. An exposure frequency (EF) of 78 days/year (3 days/week for 6 months) for 6 years (exposure duration (ED)) was assumed for these areas since they are easily accessible based on their proximity to residential areas and on evidence of trespassing. The averaging time (AT) was calculated from USEPA (1989a) as the exposure duration (ED) multiplied by 365 days/year for noncarcinogens and 70 years (lifetime) multiplied by 365 days/year for carcinogens. A body weight (BW) of 55 kg was assumed.

For present 12-17 year old area resident/trespasser dermal contact exposure, a skin surface area

(SA) was calculated based on information presented in USEPA (1989b, 1992c). For adult males and females, the average skin surface areas (SA) for the hands and forearms were summed by sex, then averaged. The skin surface area (SA) for 12-17 year old trespassers was then calculated as 80 percent of the average adult male and female skin surface area (SA) resulting in an exposed surface area of 1,540 cm^2. An adherence factor (AF) of 1 mg/cm^2 was obtained from USEPA (1992c). Dermal absorption factors (ABS) were based on USEPA Region II guidance (3 percent for dioxins and 1 percent for cadmium). All other chemicals of potential concern were qualitatively addressed for dermal contact exposure in this risk assessment. The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) are the same as ingestion exposure, except for the exposure frequency unit, which for dermal contact, is reported in events/year instead of days/year.

For present 12-17 year old resident/trespasser inhalation exposure, an outdoor suspended soil concentration (SSC) of 35 $\mu g/m^3$ (Hawley, 1985) was assumed. This concentration assumes that one-half the measured valued (70 $\mu g/m^3$) is resuspended local soil. Per direction from the USEPA Risk Assessment Specialist for the site, it was assumed that 50 percent of the inhaled particulate mass is retained (respirable fraction-RF). An inhalation rate (IR) of 0.83 m^3/hour was assumed based on an adult average rate of 20 m^3/day as reported in USEPA (1989a). An exposure time (ET) of 2 hours was assumed to be the average combined amount of time spent in Area A per day. The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) are the same as ingestion exposure.

Residents: For potential future adult and child residents in Areas A and C (Combined) and in Area B, site surface soil data were used to calculate chemical concentrations for the intake equations.

For potential future adult and child residents, daily soil ingestion rates (IR) of 100 and 200 mg/day, respectively, were obtained from (USEPA, 1991a). The fraction ingested (FI) from contaminated surface soil was conservatively assumed to be 1 for both adults and children. An exposure frequency (EF) of 350 days/year was assumed for potential future residents (USEPA, 1991a). This value was based on the assumption that residents would be away on vacation 2 weeks per year. Exposure durations (ED) were assumed to be 24 years for adults and 6 years for children (USEPA, 1991a) which corresponds to the 90th percentile national upper-bound time spent at the same residence. The averaging time (AT) was calculated in the same manner as present area resident/trespasser surface soil ingestion. An adult body weight (BW) of 70 kg and a child body weight (BW) of 15 kg were assumed (USEPA, 1991a).

For potential future residential dermal contact exposure, the skin surface area (SA) available for contact was calculated from information presented in USEPA (1989b, 1992c). For adult males and females, the skin surface areas (SA) for the hands and forearms were summed by sex, then averaged, resulting in a value of 1,920 cm^2. For children (age 0-6 years old), the average skin surface area (SA) was calculated as 25 percent of the average adult male and female skin surface area (SA), resulting in an exposed surface area of 480 cm^2. An adherence factor (AF) of 1 mg/cm^2 for adults and children was obtained from USEPA (1992c). Dermal absorption factors

(ABS) were based on USEPA Region II guidance (3 percent for dioxins and 1 percent for cadmium). All other chemicals of potential concern were qualitatively addressed for dermal contact exposure in this risk assessment. The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) values for adults and children are the same as ingestion exposure, except for the exposure frequency unit, which for dermal contact, is reported in events/year instead of days/year.

For potential future residential inhalation exposures, an outdoor suspended soil concentration (SSC) of 35 $\mu g/m^3$ was assumed (Hawley, 1985). This concentration assumes that one-half the measured value (70 $\mu g/m^3$) is resuspended local soil. Per direction from the USEPA Risk Assessment Specialist for the site, it was assumed that 50 percent of the inhaled particulate mass is retained (respirable fraction - RF). An adult inhalation rate (IR) of 0.83 m^3/hour was assumed based on an adult average rate of 20 m^3/day (USEPA, 1989a). A child inhalation rate (IR) of 0.6 m^3/hr was assumed per direction from the USEPA Risk Assessment Specialist for the site. An exposure time (ET) of 18 hours was assumed to be the average combined amount of time spent both indoors and outdoors (i.e., at home) per day. The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) values for adults and children are the same as ingestion exposure.

Site Workers/Employees: For potential future site worker/employee surface soil exposures at the site (Areas A, B, and C), site sample data were used to calculate chemical concentrations for use in the intake equations.

A daily ingestion rate (IR) of 50 mg/day was assumed for commercial land use scenarios (USEPA, 1991a). The fraction ingested (FI) from contaminated surface soil was conservatively assumed to be 1. An exposure frequency (EF) of 250 days/year (5 days/week for 12 months minus 2 weeks/year vacation) for 25 years (exposure duration (ED)) was assumed (USEPA, 1991a). The averaging time (AT) was calculated from USEPA (1989a) as the exposure duration (ED) multiplied by 365 days/year for noncarcinogens and 70 years (lifetime) multiplied by 365 days/year for carcinogens. An adult body weight (BW) of 70 kg was assumed (USEPA, 1991a).

For potential future site worker/employee dermal contact exposure, a skin surface area (SA) of 795 cm^2 was calculated based on information contained in USEPA (1989b, 1992c). For males and females, the skin surface areas (SA) for the hands were summed by sex, then averaged, resulting in the final value. An adherence factor (AF) of 1 mg/cm^2 was obtained from USEPA (1992c). The dermal absorption factor (ABS) was based on USEPA Region II guidance (3 percent for dioxins and 1 percent for cadmium). The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) are the same as site worker/employee ingestion exposure, except for the exposure frequency unit, which for dermal contact, is reported in events/year instead of days/year.

For potential future site worker/employee inhalation exposure, an outdoor suspended soil concentration (SSC) of 35 $\mu g/m^3$ was assumed (Hawley, 1985). This concentration assumes that one-half the measured value (70 $\mu g/m^3$) is resuspended local soil. Per direction from the USEPA Risk Assessment Specialist for the site, it was assumed that 50 percent of the inhaled particulate

mass is retained (respirable fraction - RF). An inhalation rate (IR) of 0.83 m^3/hour was assumed based on an adult average rate of 20 m^3/day (USEPA, 1989a). An exposure time (ET) of 8 hours was assumed, based on the length of a typical work day. The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) are the same as site worker/employee ingestion exposure.

3.5.2 Subsurface Soil

Construction Workers: For potential future construction worker subsurface soil exposure in Area A and in Area B, site sample data were used to calculate chemical concentrations for use in the intake equations.

For potential future construction workers, a subsurface soil ingestion rate (IR) of 480 mg/day was assumed based on information for the commercial/industrial setting (USEPA, 1991a). The fraction ingested (FI) from contaminated site subsurface soil was conservatively assumed to be 1. An exposure frequency (EF) of 65 days/year was assumed, which corresponds to the length of excavation activities (3 months, 5 days/week) during a construction project (i.e., over the course of a year). No vacation time is assumed during the period of excavation. The exposure duration (ED) was assumed to be 1 year, which corresponds to the assumed length of a construction project (all activities) at the site. The averaging time (AT) was calculated by the same method described for site worker surface soil ingestion. A body weight (BW) of 70 kg was assumed (USEPA, 1991a).

For potential future construction worker inhalation exposure, an outdoor suspended soil concentration (SSC) of 35 $\mu g/m^3$ was assumed (Hawley, 1985). This concentration assumes that one-half the measured value (70 $\mu g/m^3$) is resuspended local soil. Per direction from the USEPA Risk Assessment Specialist for the site, 50 percent of the inhaled particulate mass was assumed to be retained (respirable fraction-RF). An inhalation rate (IR) of 0.83 m^3/hour was assumed as described for site worker/employee inhalation exposure. An exposure time (ET) of 8 hours/day was assumed to be the length of a normal work day. The exposure frequency (EF), exposure duration (ED), averaging time (AT), and body weight (BW) are the same as ingestion exposure.

3.5.3 Ground Water

Residents: For potential future residential ground water exposure, site sample data were used to calculate chemical concentrations for use in the intake equations.

An ingestion rate (IR) of 2 liters/day was assumed for adults living at the site in the future (USEPA, 1989b). The use of 1 liter/day for children was assumed to be protective of this sensitive population. This ingestion rate was based on a long-term average consumption rate and includes drinking water consumed in the form of beverages (e.g., juices containing tap water). An exposure frequency (EF) of 350 days/year was assumed based on the assumption that 2 weeks/year are spent away from home on vacation (USEPA, 1991a). The exposure duration (ED) was assumed to be 24 years for adults and 6 years for children (USEPA, 1989a). Thirty years corresponds to the national upper-bound (90^{th} percentile) time spent at one residence. The

averaging time (AT) was calculated in the same manner as soils where the exposure duration (24 years for adults and 6 years for children for noncarcinogens, and 70 years (lifetime) for adults and children for carcinogens) is multiplied by 365 days/year. Body weights (BW) of 70 kg for adults and 15 kg for children were assumed (USEPA, 1991a).

For potential future adult resident dermal contact with ground water during showering, the dermal absorption of pesticides and inorganics have been evaluated. The skin surface area available for contact was calculated from information presented in USEPA (1989a, 1989b, and 1992c). Whole body exposure was assumed to occur during showering. For adult males and females, the average total body surface areas were summed, then averaged, resulting in a value of 18,150 cm^2. Chemical-specific dermal permeability constants were obtained from USEPA (1992c). When a dermal permeability constant was not available for a specific chemical, the dermal permeability constant for water was utilized as a default value. An exposure time (ET) of 0.5 hour/day (30 minutes) was assumed. This period of time includes the time of the shower and the time spent in the bathroom after showering. A time of 12 minutes (0.2 hour) is assumed to be the length of a typical shower and is the 90th percentile value specified in USEPA (1989a). As discussed in the Shower Model (Andelman, 1990; Schaum et al., 1994), 20 minutes (0.3 hours) is the assumed time spent in the bathroom after showering. An exposure frequency (EF) of 350 days/year was assumed for daily showering, taking into account 2 weeks/year spent away from home (USEPA, 1991a). The exposure duration (ED) was assumed to be 24 years for adults (USEPA, 1989a). The averaging time (AT) was calculated in the same manner as residential ground water ingestion. An adult body weight (BW) of 70 kg was assumed (USEPA, 1991a). Children age 0-6 years old

were not evaluated from dermal contact while showering since they are likely to take baths only during their early years.

Site Workers/Employees: For potential future site worker/employee ground water exposure, site sample data were used to calculate chemical concentrations for use in the ingestion intake equation.

An ingestion rate (IR) of 1 liter/day was assumed for the commercial/industrial setting (USEPA, 1991a) since it is assumed that other beverages would be ingested besides water. An exposure frequency (EF) of 250 days/year (5 days/week for 12 months minus 2 weeks/year vacation) for 25 years (exposure duration (ED)) was assumed (USEPA, 1991a). The averaging time (AT) was calculated in the same manner as residential ground water ingestion. A body weight (BW) of 70 kg was assumed (USEPA, 1991a).

3.5.4 Surface Water

Area Residents/Trespassers: For present area residents/trespassers at the site, site surface water data were used to calculate chemical concentrations for the dermal contact intake equation.

For present 12-17 year old area resident/trespasser dermal contact exposure in the Drainage Ditches in all areas and swampy location of Area B (includes Drainage from Area A through Area C and from Area A through Area B), a skin surface area (SA) was calculated based on information

presented in USEPA (1989b, 1992c). For adult males and females, the average skin surface areas (SA) for the hands and feet were summed by sex, then averaged. The skin surface area (SA) for 12-17 year old trespassers was then calculated as 80 percent of the average adult male and female skin surface area (SA), resulting in an exposed surface area of 1,470 cm^2. The dermal permeability constant (PC) for water was utilized as a default value when chemical-specific values were not available in the literature. The exposure time (ET) was assumed to 0.5 hour/day since surface water in this location is too shallow to support formal recreational activities. An exposure frequency (EF) of 26 days/year (1 day/week for 6 months) was assumed. An exposure duration (ED) of 6 years was assumed for 12-17 year old area residents/trespassers. The averaging time (AT) was calculated in the same manner as residential ground water ingestion. A body weight (BW) of 55 kg was assumed.

Residents: For potential future site residents, site surface water data were used to calculate chemical concentrations for use in the dermal contact intake equation.

For potential future adult and child resident dermal contact exposure in the Drainage Ditches in all areas and swampy location of Area B (includes Drainage from Areas A through C and from A through B), skin surface areas (SA) were calculated in the same manner as the area resident/trespasser skin surface area. For children 12-17 years old, 80 percent of the adult average skin surface area (SA) of 1,470 cm^2 was calculated based on information presented in USEPA (1989b, 1992c). For adults, the whole value, 1,840 cm^2, was used based on information presented in USEPA (1989b, 1992c). As for area resident/trespasser dermal contact with surface

water, the dermal permeability constant (PC) for water was utilized as a default value when chemical-specific values were not available in the literature. The exposure time (ET) is the same time as the area resident/trespasser surface water exposure time. Exposure frequencies (EF) of 12 days/year (2 days/month for 6 months) for adults and 26 days (1 day/week for 6 months) for children 12-17 years old were assumed, as children are expected to have more recreational time than adults. The exposure duration (ED) and averaging time (AT) were calculated in the same manner as residential ground water ingestion. Body weights (BW) of 70 kg for adults and 55 kg for children 12-17 years old were assumed.

3.5.5 Sediment

Area Residents/Trespassers: For present area residents/trespassers at the site, site sediment data were used to calculate chemical concentrations for the dermal contact intake equation.

For present 12-17 year old area resident/trespasser dermal contact exposure in the Drainage Ditches in all areas and swampy location of Area B (includes Drainage from Area A through Area C and from Area A through Area B), the skin surface area (SA) was calculated in the same manner as the area resident/trespasser surface water skin surface area. A soil-to-skin adherence factor (AF) of 1 mg/cm^2 was obtained from USEPA (1992c). Sediment dermal contact absorption factors (ABS) were based on USEPA Region II guidance and are the same as those reported for soils. An exposure frequency (EF) of 26 events/year (1 event/week for 6 months) was assumed. An exposure duration (ED) of six years was assumed for 12-17 year old area residents/trespassers.

The averaging time (AT) was calculated in the same manner as residential ground water ingestion. A body weight (BW) of 55 kg was assumed.

Residents: For potential future site residents, site sediment data were used to calculate chemical concentrations for use in the dermal contact intake equation.

For potential future adult and child resident dermal contact exposures in the Drainage Ditches in all areas and swampy location of Area B (includes Drainage from Area A through Area C and from Area A through Area B), skin surface areas (SA) were calculated in the same manner as the resident surface water skin surface areas. The soil-to-skin adherence factor (AF) and sediment dermal absorption factors (ABS) are the same as for area resident/trespasser sediment dermal contact exposure. Exposure frequencies (EF) of 12 events/year (2 events/month for 6 months) for adults and 26 events/year (1 event/week for 6 months) for children 12-17 years old were assumed, as children are expected to have more recreational time than adults. Exposure durations (ED) were assumed to be 24 years for adults and 6 years for children (USEPA, 1991a) which correspond to the adult and child surface water exposure durations, since the same recreational activities would be occurring. The averaging time (AT) was calculated in the same manner as residential ground water ingestion. Body weights (BW) of 70 kg for adults and 55 kg for children 12-17 years old were assumed.

4.0 TOXICITY ASSESSMENT

The toxicity assessment presents the general toxicological properties of the selected chemicals of potential concern using the most current toxicological human health effects data. Toxicity profiles for each of the chemicals of potential concern are presented in Appendix B.

Each chemical can produce a wide variety of human health effects. While only certain chemicals produce potentially carcinogenic effects, all chemicals have the potential to produce noncarcinogenic effects, depending on the type and duration of exposure. The USEPA has developed a qualitative weight-of-evidence classification system in which available data for a chemical are evaluated to determine the likelihood that the agent is a human carcinogen. Evidence is characterized separately for human and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined and the chemical is given a provisional weight-of-evidence classification based on the extent to which the agent has been shown to be carcinogenic in experimental animals, humans, or both. Supporting evidence of carcinogenicity may adjust the provisional weight-of-evidence classification up or down. The USEPA weight-of-evidence classification system for carcinogenicity, as discussed in Section 2.3, is described again below for the purposes of clarity.

GROUP	DESCRIPTION
A	Human Carcinogen.
B1	Probable Human Carcinogen. Limited human data are available.
B2	Probable Human Carcinogen. Sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans.
C	Possible Human Carcinogen.
D	Not Classifiable as to human carcinogenicity.
E	Evidence of noncarcinogenicity for humans.

Two measurements used to quantify the toxic effects of a chemical on human health include a chemical's carcinogenic slope factor (SF) and noncarcinogenic reference dose (RfD). Many of the carcinogenic slope factors and reference doses used in this assessment were obtained from the USEPA's IRIS data base. IRIS is an on-line data base which is updated monthly. It provides chemical-specific risk data that represent a USEPA scientific consensus. The quantitative risk values and supporting explanations in IRIS have been reviewed and agreed upon by scientists across the USEPA using the available studies performed on a chemical. Slope factors and reference doses/concentrations not available on IRIS were obtained from the USEPA's second most current source of toxicity information, HEAST FY 1994-Annual (USEPA, 1994). Per HEAST direction, the Superfund Health Risk Technical Support Center was contacted for toxicity information for two chemicals on July 3, 1995.

4.1 Health Effects Criteria for Carcinogens

Generally, a slope factor is a plausible, upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. In risk assessment, a slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of exposures of varying exposure periods. Slope factors are verified by the USEPA's Carcinogen Risk Assessment Verification Endeavor (CRAVE) Workgroup. Slope factors for the carcinogenic chemicals of potential concern are presented in Table 4-1. Oral and inhalation unit risk estimates were converted to slope factors, per HEAST and USEPA Region II guidance, by multiplying by 70 kg (assumed human body weight), dividing by 20 m^3/day (assumed human inhalation rate) or by 2 liters/day (assumed human water consumption rate) and multiplying by 1,000 μg/mg (conversion factor). The slope factor, which is usually the upper 95th percent confidence limit of the slope of the dose-response curve, is expressed in $(mg/kg\text{-}day)^{-1}$. It represents the probability of an individual developing cancer as a result of chronic exposure to a given carcinogenic chemical over a specified exposure period. A risk of 10^{-6} indicates that the probability of an individual developing cancer from a given exposure is unlikely to exceed one in one million (10^6).

In several instances, when slope factors were not available for specific chemicals, the slope factor for one isomer or compound within a chemical class was used to represent the slope factor for all other isomers or chemicals in the same class (i.e., PAHs). For several carcinogenic PAHs, the benzo(a)pyrene slope factor was used in conjunction with relative potency values to develop slope factors for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and

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TABLE 4-1

PULVERIZING SERVICES SITE
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	CARCINOGENS: SLOPE FACTORS (SF)		
	Oral SF (mg/kg-day)-1	Inhalation SF (mg/kg-day)-1	Weight - of - Evidence
Volatile Organics			
Acetone	-	-	D
Benzene	2.9E-02	2.9E-02	A
Carbon Tetrachloride	1.3E-01	5.3E-02	B2
Chlorobenzene	-	-	D
Chloroform	6.1E-03	8.1E-02	B2
2-Butoxyethanol (Ethylene glycol monobutyl ether) (TIC)	-	-	-
Ethylbenzene	-	-	D
Methylene Chloride	7.5E-03	1.6E-03	B2
Tetrachloroethene	5.2E-02 (3)	2.0E-03 (3)	B2-C
Toluene	-	-	D
Xylenes (Total)	-	-	D
Semivolatile Organics			
Acenaphthene	-	-	-
Anthracene	-	-	D
Benzaldehyde (TIC)	-	-	-
N,N-Dimethyl-alpha-phenyl benzeneacetamide (Diphenamid) (TIC)	-	-	-
1-Methylethylbenzene (Cumene) (TIC)	-	-	-
Benzo(a)anthracene	7.3E-01*	-	B2
Benzo(a)pyrene	7.3E+00*	-	B2
Benzo(b)fluoranthene	7.3E-01*	-	B2
Benzo(g,h,i)perylene	-	-	D
Benzo(k)fluoranthene	7.3E-02*	-	B2
Bis(2-ethylhexyl)phthalate	1.4E-02	-	B2
Butylbenzylphthalate	-	-	C
Phenylcarbamic acid 1-methylethyl ester (Propham) (TIC)	-	-	-
4-Chloroaniline	-	-	-
Chlorobenzilate (TIC)	2.7E-01 (2)	2.7E-01 (2)	B2
Chrysene	7.3E-03*	-	B2
Di-n-butylphthalate	-	-	D
Diethylphthalate	-	-	D
Fluoranthene	-	-	D
Fluorene	-	-	D
Hexachlorobenzene	1.6E+00	1.6E+00	B2
Hexachlorophene (TIC)	-	-	-
2-Imidazolidinethione (Ethylene thiourea) (TIC)	1.1E-01 (2)	-	B2
Indeno(1,2,3-cd)pyrene	7.3E-01*	-	B2
2-Methylnaphthalene	-	-	-
4-Methylphenol	-	-	C

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TABLE 4-1

PULVERIZING SERVICES SITE
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	CARCINOGENS: SLOPE FACTORS (SF)		
	Oral SF (mg/kg-day)-1	Inhalation SF (mg/kg-day)-1	Weight - of - Evidence
Semivolatile Organics (Cont'd)			
N-Nitrosodiphenylamine	4.9E-03	-	B2
Naphthalene	-	-	D
Penoxaline (Pendimethalin) (TIC)	-	-	-
Phenanthrene	-	-	D
Phenol	-	-	D
Phthalic anhydride (TIC)	-	-	-
Pyrene	-	-	D
Tetrachloroisopthalonitrile (Chlorothalonil) (TIC)	1.1E-02 (2)	-	B2
Pesticides/PCBs			
Aldrin	1.7E+01	1.7E+01	B2
Chlordane	1.3E+00 (4)	1.3E+00 (4)	B2
4,4'-DDD	2.4E-01	-	B2
4,4'-DDE	3.4E-01	-	B2
4,4'-DDT	3.4E-01	3.4E-01	B2
alpha-BHC	6.3E+00	6.3E+00	B2
beta-BHC	1.8E+00	1.9E+00	C
delta-BHC	-	-	D
gamma-BHC (Lindane, Total)	1.3E+00 (2)	-	B2-C
Dieldrin	1.6E+01	1.6E+01	B2
Endosulfan (4)	-	-	-
Endrin (Total)	-	-	D
Endrin Ketone	-	-	-
Malathion	-	-	-
Methoxychlor	-	-	D
Rotenone	-	-	-
Sevin	-	-	-
Fungicides			
PCNB	2.6E-01 (2)	-	C
Dioxin			
2,3,7,8-TCDD	1.5E+05 (2)	1.5E+05 (2)	B2
Inorganics			
Aluminum	-	-	-
Antimony	-	-	-
Arsenic	1.75E+00	1.5E+01	A
Barium	-	-	-
Beryllium	4.3E+00	8.4E+00	B2
Cadmium	-	6.3E+00	B1

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TABLE 4-1

PULVERIZING SERVICES SITE
TOXICITY VALUES FOR POTENTIAL CARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	CARCINOGENS: SLOPE FACTORS (SF)		
	Oral SF (mg/kg-day)-1	Inhalation SF (mg/kg-day)-1	Weight - of - Evidence
Inorganics (Cont'd)			
Chromium III	-	-	-
Chromium VI	-	4.2E+01	A
Cobalt	-	-	-
Copper	-	-	D
Cyanide	-	-	D
Lead (and compounds-inorg.)	-	-	B2
Manganese (water)	-	-	D
Mercury	-	-	D
Nickel (sol. salt)	-	-	-
Selenium	-	-	D
Thallium (chloride)	-	-	D
Vanadium	-	-	-
Zinc (and compounds)	-	-	D

NOTES:

- Calcium, iron, magnesium, potassium, and sodium are considered essential nutrients and will not be quantitatively evaluated in the risk assessment.
*Relative potency values were used in conjunction with slope factors per USEPA Guidance (USEPA, 1993a).
(1) All toxicity values were obtained from IRIS (on-line June 26 through 28 and July 3, 1995) unless otherwise noted.
(2) Toxicity values were obtained from HEAST Annual FY-1994.
(3) Toxicity values were verified by the Superfund Health Risk Technical Support Center (July 3, 1995).
(4) The carcinogenic toxicity values for chlordane are reported, as the gamma-chlordane isomer does not have established toxicity values.
(5) No carcinogenic toxicity values are currently established for endosulfan or its isomer endosulfan I.

USEPA WEIGHT - OF - EVIDENCE:

A - Human Carcinogen
B1 - Probable Human Carcinogen. Limited human data are available.
B2 - Probable Human Carcinogen. Sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans.
C - Possible Human Carcinogen
D - Not Classifiable as to human carcinogenicity.
E - Evidence of noncarcinogenicity for humans.

indeno(1,2,3-cd)pyrene, in accordance with the Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (USEPA, 1993a).

Since benzo(a)pyrene is more toxic than some of the other PAH congeners, these procedures may overestimate the risks and hazards generated as part of this assessment and are, therefore, a source of uncertainty in this risk assessment.

4.2 Health Effects Criteria for Noncarcinogens

The determination of the potential health hazards associated with exposure to noncarcinogens was made by comparing the estimated chronic or subchronic daily intake of a chemical with the reference dose. Various reference doses are available depending on the exposure route, the critical effect, and the length of exposure evaluated in the scenario. For this assessment, both chronic and subchronic reference doses (RfDs) were used. It should be noted that inhalation RfDs were developed by converting a concentration in air (mg/m^3) to a corresponding inhaled dose (mg/kg-day) by dividing by 70 kg (assumed human body weight) and multiplying by 20 m^3/day (assumed human inhalation rate) per HEAST and USEPA Region II direction. Tables 4-2 and 4-3 present these values along with their uncertainty factors.

A chronic reference dose is defined as an estimate (with uncertainty spanning possibly an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a

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TABLE 4-2

PULVERIZING SERVICES SITE
CHRONIC TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Volatile Organics				
Acetone	1.0E-01	1000	-	-
Benzene	-	-	-	-
Carbon Tetrachloride	7.0E-04	1000	-	-
Chlorobenzene	2.0E-02	1000	5.0E-03 (2)	10000
Chloroform	1.0E-02	1000	-	-
2-Butoxyethanol (Ethylene glycol monobutyl ether) (TIC)	-	-	5.7E-03 (2)	1000
Ethylbenzene	1.0E-01	1000	2.9E-01	300
Methylene Chloride	6.0E-02	100	8.6E-01 (2)	100
Tetrachloroethene	1.0E-02	1000	-	-
Toluene	2.0E-01	1000	1.1E-01	300
Xylenes (Total)	2.0E+00	100	-	-
Semivolatile Organics				
Acenaphthene	6.0E-02	3000	-	-
Anthracene	3.0E-01	3000	-	-
Benzaldehyde (TIC)	1.0E-01	1000	-	-
N,N-Dimethyl-alpha-phenyl benzeneacetamide (Diphenamid) (TIC)	3.0E-02	100	-	-
1-Methylethylbenzene (Cumene) (TIC)	4.0E-02	3000	2.6E-03 (2)	10000
Benzo(a)anthracene	-	-	-	-
Benzo(a)pyrene	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-
Bis(2-ethylhexyl)phthalate	2.0E-02	1000	-	-
Butylbenzylphthalate	2.0E-01	1000	-	-
Phenylcarbamic acid 1-methylethyl ester (Propham) (TIC)	2.0E-02	3000	-	-
4-Chloroaniline	4.0E-03	3000	-	-
Chlorobenzilate (TIC)	2.0E-02	300	-	-
Chrysene	-	-	-	-
Di-n-butylphthalate	1.0E-01	1000	-	-
Diethylphthalate	8.0E-01	1000	-	-
Fluoranthene	4.0E-02	3000	-	-
Fluorene	4.0E-02	3000	-	-
Hexachlorobenzene	8.0E-04	100	-	-
Hexachlorophene (TIC)	3.0E-04	3000	-	-
2-Imidazolidinethione (Ethylene thiourea) (TIC)	8.0E-05	3000	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-
2-Methylnaphthalene	-	-	-	-
4-Methylphenol	5.0E-03 (2)	1000	-	-

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TABLE 4-2

PULVERIZING SERVICES SITE
CHRONIC TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Semivolatile Organics (Cont'd)				
N-Nitrosodiphenylamine	-	-	-	-
Naphthalene	4.0E-02 (3)	1000	-	-
Penoxaline (Pendimethalin) (TIC)	4.0E-02	300	-	-
Phenanthrene	-	-	-	-
Phenol	6.0E-01	100	-	-
Phthalic anhydride (TIC)	2.0E+00	1000	3.4E-02 (2)	300
Pyrene	3.0E-02	3000	-	-
Tetrachloroisopthalonitrile (Chlorothalonil) (TIC)	1.5E-02	100	-	-
Pesticides/PCBs				
Aldrin	3.0E-05	1000	-	-
Chlordane	6.0E-05 (4)	1000	-	-
4,4'-DDD	-	-	-	-
4,4'-DDE	-	-	-	-
4,4'-DDT	5.0E-04	100	-	-
alpha-BHC	-	-	-	-
beta-BHC	-	-	-	-
delta-BHC	-	-	-	-
gamma-BHC (Lindane, Total)	3.0E-04	1000	-	-
Dieldrin	5.0E-05	100	-	-
Endosulfan	6.0E-03 (5)	100	-	-
Endrin (Total)	3.0E-04	100	-	-
Endrin Ketone	-	-	-	-
Malathion	2.0E-02	10	-	-
Methoxychlor	5.0E-03	1000	-	-
Rotenone	4.0E-03	100	-	-
Sevin	1.0E-01	100	-	-
Fungicides				
PCNB	3.0E-03	300	-	-
Dioxin				
2,3,7,8 - TCDD	-	-	-	-
Inorganics				
Aluminum	-	-	-	-
Antimony	4.0E-04	1000	-	-
Arsenic	3.0E-04	3	-	-
Barium	7.0E-02	3	1.0E-04 (2)	1000
Beryllium	5.0E-03	100	-	-
Cadmium (food)	1.0E-03	10	-	-
Cadmium (water)	5.0E-04	10	-	-

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TABLE 4-2

PULVERIZING SERVICES SITE
CHRONIC TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Inorganics (Cont'd)				
Chromium III	1.0E+00	100	-	-
Chromium VI	5.0E-03	500	-	-
Cobalt	-	-	-	-
Copper*	-	-	-	-
Cyanide	2.0E-02	100	-	-
Lead (and compounds-inorg.)	-	-	-	-
Manganese (water)	5.0E-03	1	1.4E-05	1000
Mercury	3.0E-04 (2)	1000	8.6E-05	30
Nickel (sol. salt)	2.0E-02	300	-	-
Selenium	5.0E-03	3	-	-
Thallium (chloride)	8.0E-05	3000	-	-
Vanadium	7.0E-03 (2)	100	-	-
Zinc (and compounds)	3.0E-01	3	-	-

NOTES:

- Calcium, iron, magnesium, potassium, and sodium are considered essential nutrients and are not quantitatively evaluated in the risk assessment.
*The current drinking water standard for copper is 1.3 mg/l. The DWCD (1987) concluded that toxicity data are inadequate for calculation of a reference dose for this chemical.
(1) All toxicity values were obtained from IRIS (on-line June 26 through 28 and July 3, 1995) unless otherwise noted.
(2) Toxicity values were obtained from HEAST Annual FY-1994.
(3) Toxicity values were verified by the Superfund Health Risk Technical Support Center (July 3, 1995).
(4) The noncarcinogenic toxicity value for chlordane is reported, as the gamma-chlordane isomer does not have established noncarcinogenic toxicity values.
(5) The noncarcinogenic toxicity value for endosulfan is reported, as the endosulfan I isomer does not have established noncarcinogenic toxicity values.

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TABLE 4-3

PULVERIZING SERVICES SITE
SUBCHRONIC TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC HEALTH EFFECTS
DOSE - RESPONSE RELATIONSHIP (1)

CHEMICALS	NONCARCINOGENS: SUBCHRONIC REFERENCE DOSES (RfD)			
	Oral RfD (mg/kg-day)	Uncertainty Factor	Inhalation RfD (mg/kg-day)	Uncertainty Factor
Pesticides				
Aldrin	3.0E-05	1000	-	-
alpha-BHC	-	-	-	-
4,4'-DDE	-	-	-	-
4,4'-DDT	5.0E-04	100	-	-
Dieldrin	5.0E-05	100	-	-
Inorganics				
Arsenic	3.0E-04	3	-	-
Manganese (water)	5.0E-03	1	-	-

NOTES:
- Calcium, iron, magnesium, potassium, and sodium are considered essential nutrients and are not quantitatively evaluated in the risk assessment.
(1) Toxicity values were obtained from HEAST Annual FY-1994.

lifetime. The chronic reference doses derived by the USEPA's RfD Workgroup are specifically developed to be protective for long-term exposure to a chemical. Subchronic reference doses are useful in characterizing potential noncarcinogenic effects associated with shorter-term exposure. In this risk assessment, exposures of six years and greater were considered chronic while exposures of less than six years were considered subchronic. A six year exposure is at the upper-bounds of subchronic exposure and therefore chronic toxicity values are more appropriately used.

For many noncarcinogenic effects, it is believed that protective mechanisms exist which must be overcome before an adverse effect is manifested. For example, when a large number of cells perform the same or similar function, a significant number of the cells may have to be depleted before an effect is seen. Therefore, there is a range of exposures between zero and some finite value that can be tolerated by the organism with essentially no chance of expression of adverse effects.

Oral and inhalation chronic reference doses/concentrations are derived from the no-observed-adverse-effect-level (NOAEL) or the lowest-observed-adverse-effect-level (LOAEL) for the critical toxic effect by application of uncertainty factors (UFs) and a modifying factor (MF-oral only). Subchronic reference doses/concentrations are derived from subchronic NOAELs by application of UFs and MFs as done for chronic reference doses/concentrations. The distinction between the two reference doses/concentrations lies with exposure duration which is shorter for subchronic studies.

Uncertainty related to toxicity information will be discussed in Section 6.0, Uncertainties in Risk Assessment.

4.3 Qualitative Discussion of Chemicals Not Quantitatively Evaluated in the Risk Assessment

Numerous SVOCs, pesticides, and inorganics could not be quantitatively evaluated in this risk assessment due to the lack of established toxicity values. This section presents brief toxicological profiles for these chemicals.

benzo(g,h,i)perylene - This chemical is a PAH and is currently classified in Group D - Not classifiable as to human carcinogenicity (USEPA, 1995). PAHs are a ubiquitous class of chemicals formed during the combustion of fossil fuels (Klaassen et al., 1986). Little information is available regarding nonmalignant changes due to PAH exposure although liver and kidney effects may occur (Clement Associates, Inc., 1985).

2-methylnaphthalene - This chemical is a PAH which has not currently been given a weight-of evidence classification. No specific toxicity information for this chemical was located in the literature.

phenanthrene - This PAH has been given a Group D weight-of-evidence classification (USEPA, 1995). Although limited information is available regarding nonmalignant changes due to PAH exposure, generally, liver and kidney effects may occur (Clement, Associates Inc., 1985).

delta-BHC - This chemical is one of four isomers of hexachlorocyclohexane (HCH) or benzene hexachloride (BHC). As a group, these chemicals are fairly persistent in the environment. (Clement Associates Inc., 1985). The delta isomer is considered a central nervous system depressant (Klaassen et al., 1986). This chemical has been given a Group D weight-of-evidence classification (USEPA, 1995).

endrin ketone - Endrin is a persistent cyclodiene insecticide that is an isomer of dieldrin. It is highly toxic to mammals, although it has not been shown to be carcinogenic. Endrin is a neurotoxicant and may produce headache and nausea, vomiting, dizziness, and mild chronic jerking. Convulsions may occur with no warning symptoms. (Klaassen et al., 1986).

aluminum - This chemical is ubiquitous in the environment. It may affect the absorption of other elements in the gastrointestinal tract and may alter intestinal function. There has been increasing interest in the possible relationship of aluminum to dementia in humans (Wills and Savory, 1983; Klaassen et al., 1986).

cobalt - This chemical is a component of vitamin B_{12} required for the production of red blood cells and prevention of pernicious anemia. Ingestion of excessive amounts of cobalt in humans may cause polycythemia. High levels of chronic oral administration may result in goiter. Occupational inhalation of cobalt salts may result in respiratory symptoms. (Klaassen et al., 1986).

copper - This chemical is an essential element widely distributed in nature. Acute poisoning from

ingestion of excessive amounts of oral copper salts may produce death. Symptoms include vomiting, hematemesis, hypotension, melena, coma, and jaundice (Klaassen et al., 1986). A full toxicological for this chemical is located in Appendix B Toxicological Profiles.

iron - This chemical is an essential element (Klaassen et al., 1986). The ingestion of excessive amounts of this inorganic can irritate the gastrointestinal tract. Inhaling some iron containing dusts and fumes can cause siderosis, a type of benign pneumoconiosis (Clement Associates, Inc., 1985)

lead - A full toxicological profile for this chemical is located in Appendix B Toxicological Profiles due to the extensive amount of information available and its Group B2 weight-of-evidence classification (USEPA, 1995).

The inability to quantitatively evaluate these chemicals (and other essential nutrients) is a source of uncertainty in this risk assessment as the potential for underestimation of risks or health impacts exists. Uncertainty related to chemical toxicity data is addressed further in Section 6.0 Uncertainties in Risk Assessment.

5.0 RISK CHARACTERIZATION

The characterization of potential carcinogenic risks and noncarcinogenic health effects estimates associated with the "no action" alternative were evaluated for the exposure pathways identified in Section 3.2. The spreadsheet calculations are presented in Appendix C.

5.1 Carcinogenic Risk Characterization

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen (i.e., incremental or excess individual lifetime cancer risk).

The slope factor converts estimated daily intakes averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. Since the slope factor is often an upper 95th percentile confidence limit of the probability of response based on experimental animal data used in the multistage model, the carcinogenic risk estimate will generally be an upper-bound estimate. This means that the USEPA is reasonably confident that the "true risk" will not exceed the risk estimate derived through use of this model and is likely to be less than that predicted. Since relatively low intakes (in comparison to those experienced by test animals) are most likely from environmental exposures at Superfund sites, the USEPA assumes that the dose-response relationship is linear in the low dose portion of the multistage model dose-response curve. Under this assumption, the slope factor is constant and risk will be directly related to intake. Therefore,

the linear form of the carcinogenic risk equation, as presented below, was used to estimate risk.

$$\text{Risk} = \text{CDI} \times \text{SF}$$

Where:

Risk = a unitless probability of an individual developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor expressed in $(\text{mg/kg-day})^{-1}$

5.2 Noncarcinogenic Effects Characterization

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (i.e., 30 years) with a reference dose (or concentration) derived for a similar exposure period. This ratio of exposure to toxicity is referred to as a hazard quotient; the sum of the individual hazard quotients is referred to as a hazard index. The formula for the hazard index is presented below.

$$\text{Noncancer Hazard Index} = E_1/RfD_1 + E_2/RfD_2 + E_i/RfD_i$$

Where:

E = Exposure Intake (chronic or subchronic) for the i^{th} chemical

RfD = Reference Dose (chronic or subchronic) for the i^{th} chemical

The noncancer hazard quotient assumes that there is a level of exposure (i.e., RfD) below which

it is unlikely even for a sensitive population to experience adverse health effects. If the exposure intake exceeds the threshold (i.e., the noncancer hazard quotient or index exceeds one), there may be concern for potential noncancer effects. Generally, the greater the value of the noncancer hazard quotient or index above one, the greater the level of concern. However, the ratio should not be interpreted as a statistical probability. It is important to note that the level of concern does not increase linearly as the RfD is approached or exceeded, as RfDs do not have equal accuracy or precision and are not based on the same severity of toxic effects.

If the hazard index does exceed one due to the summing of several hazard quotients, segregation of the hazard index by critical effect or mechanism is performed (see Section 5.5).

5.3 Quantitative Results of Carcinogenic Risk and Noncarcinogenic Effects Evaluation

In accordance with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) Section 300.430(e)(2) for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6}. Per RAGS Part B: Development of Risk-Based Preliminary Remediation Goals (USEPA, 1991b), for noncarcinogenic effects, the NCP implies a hazard index of one.

In general, the USEPA recommends target values or ranges (i.e., risk = 10^{-4} to 10^{-6} or hazard index = 1) as threshold values for potential human health impacts (USEPA, 1989a). These values

aid in determining the objectives of the baseline human health risk assessment which include determining whether additional response action is necessary at the site, by providing a basis for determining residual chemical levels that are adequately protective of human health, by providing a basis for comparing potential health impacts of various remedial alternatives, and to help support selection of the "no action" remedial alternative, where appropriate.

Tables C-1 through C-34 in Appendix C present the results of carcinogenic risk and noncarcinogenic health hazard calculations for the environmental matrices and human receptors quantitatively evaluated in this risk assessment.

5.3.1 Surface Soil

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident (trespasser), potential future resident, and potential future site worker/employee surface soil exposures in Areas A, B, C, and A and C (Combined) are presented in Tables C-1 through C-19 in Appendix C.

Area A - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area residents/trespassers in Area A are presented in Tables C-1 and C-2 of Appendix C.

Table C-1, present area resident/trespasser surface soil ingestion in Area A, shows a total carcinogenic risk of 1.3E-03. This risk exceeds the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. Dieldrin shows an individual risk of 1.2E-03 and contributes greater than 92 percent to the total risk.

The hazard index for present area resident/trespasser surface soil ingestion in Area A is 2.3E+01. This hazard index exceeds the USEPA's target level of one. Dieldrin and 4,4'-DDT show individual hazard quotients of 1.7E+01 and 5.3E+00, respectively, and combined contribute nearly 97 percent to the hazard index. The target organ for both of these chemicals is the liver.

Table C-2, present area resident/trespasser surface soil inhalation in Area A, shows a total carcinogenic risk of 3.7E-07. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

A hazard index risk for present area residents/trespasser surface soil inhalation in Area A could not be calculated as no chemicals of potential concern have currently established inhalation reference doses.

Area B - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area residents/trespassers in Area B are presented in Tables C-3 and C-4 of Appendix C.

Table C-3, present area resident/trespasser surface soil ingestion in Area B, shows a total carcinogenic risk of 4.9E-06. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for present area resident/trespasser surface soil ingestion in Area B, 2.5E-01, falls below the USEPA's target level of one.

Table C-4, present area resident/trespasser dermal contact with surface soil in Area B, shows a total carcinogenic risk of 2.5E-08. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for present area resident/trespasser dermal contact with surface soil in Area B could not be calculated as 2,3,7,8-TCDD does not currently have an established noncarcinogenic toxicity value and no other chemicals of potential concern have established dermal absorption factors.

Area C - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations of present area residents/trespassers in Area C are presented in Tables C-5 and C-6 of Appendix C.

Table C-5, present area resident/trespasser surface soil ingestion in Area C, shows a total carcinogenic risk of 1.3E-06. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for present area resident/trespasser surface soil ingestion in Area C, 5.4E-02, falls well below the USEPA's target level on one.

Table C-6, present area resident/trespasser dermal contact with surface soil in Area C, shows a total carcinogenic risk of 3.2E-08. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for present area resident/trespasser dermal contact with surface soil in Area C could not be calculated as 2,3,7,8-TCDD does not currently have an established oral reference dose and no other chemicals of potential concern have established dermal absorption factors.

Areas A - C (Combined) - Residents

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future residents in Area A and C (Combined) are presented in Tables C-7 and C-8 of Appendix C.

Table C-7, potential future residential surface soil ingestion in Areas A and C (Combined), shows total carcinogenic risks for adults and children of 1.8E-02 and 4.2E-02, respectively. Both risks exceed the upper-bound of the USEPA's target risk range. For adults, aldrin, dieldrin, and 4,4'-DDT show individual risks which range from 5.5E-04 to 1.7E-02 and combined are responsible for the entire risk. For children, aldrin, dieldrin, and 4,4'-DDT show individual risks which range from 1.3E-03 to 3.9E-02 and combined are responsible for the entire risk. The 30-year

combined total risk for adults and children, 6.1E-02, also exceeds the upper-bound of the USEPA's target risk range.

The hazard index values for potential future adult and child surface soil ingestion in Areas A and C (Combined) are 8.2E+01 and 7.7E+02, respectively. Both hazard index values far exceed the USEPA's target level of one. For adults, aldrin, dieldrin, and 4,4'-DDT show individual hazard quotients which range from 3.2E+00 to 6.0E+01. These chemicals combined are responsible for the entire hazard index. The target organ for all three chemicals is the liver. For children, aldrin, dieldrin, and 4,4'-DDT show individual hazard quotients which range from 2.9E+01 to 5.6E+02. These chemicals combined are responsible for the entire hazard index. The target organ for all three chemicals is the liver.

Table C-8, potential future residential indoor and outdoor surface soil inhalation in Areas A and C (Combined), shows total carcinogenic risks for adults and children of 4.8E-05 and 4.0E-05, respectively. These risks fall within the USEPA's 10^{-4} to 10^{-6} target risk range. The 30-year combined total risk for adults and children, 8.8E-05, also falls within the USEPA's target risk range.

The hazard index values for potential future adult and child indoor and outdoor surface soil inhalation in Areas A and C (Combined) could not be calculated as no chemicals of potential concern have currently established inhalation reference doses.

Area B - Residents

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future residents in Area B are presented in Tables C-9 through C-11 of Appendix C.

Table C-9, potential future residential surface soil ingestion in Area B, shows total carcinogenic risks for adults and children of 6.9E-05 and 1.6E-04, respectively. While the adult risk falls within the USEPA's target risk range, the child total risk exceeds the upper-bound of the target risk range. For children, no chemicals individually exceed the target risk range, although benzo(a)pyrene, 4,4'-DDT, and arsenic combined contribute more than 86 percent to the total risk. The 30-year combined total risk for adults and children, 2.3E-04, exceeds the upper-bound of the USEPA's target risk range.

The hazard index values for potential future adult and child surface soil ingestion in Area B are 8.8E-01 and 8.2E+00, respectively. The hazard index value for children exceeds the USEPA's target level of one. 4,4'-DDT shows a hazard quotient of 7.2E+00 and contributes nearly 88 percent to the hazard index. No other chemicals show hazard quotients in exceedance of one.

Table C-10, potential future residential dermal contact with surface soil in Area B, shows total carcinogenic risks for adults and children of 4.5E-07 and 1.3E-07, respectively. Both risks fall below the USEPA's 10^{-4} to 10^{-6} target risk range. The 30-year combined total risk for adults and children, 5.8E-07, also falls below the USEPA's target risk range.

The hazard index values for potential future adult and child dermal contact with surface soil in Area B could not be calculated as 2,3,7,8-TCDD does not currently have an established noncarcinogenic toxicity value. No other chemicals of potential concern have established dermal absorption factors.

Table C-11, potential future residential indoor and outdoor surface soil inhalation in Area B, shows total carcinogenic risks for adults and children of 3.9E-07 and 3.3E-07, respectively. These risks fall below the USEPA's 10^{-4} to 10^{-6} target risk range. The 30-year combined total risk for adults and children, 7.2E-07, also falls below the USEPA's target risk range.

The hazard index values for potential future adult and child indoor and outdoor surface soil inhalation in Area B are 4.1E-02 and 1.4E-01, respectively. Both hazard index values fall below the USEPA's target level of one.

Area A - Site Workers/Employees

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future site workers/employees in Area A are presented in C-12 and C-13 of Appendix C.

Table C-12, potential future site worker/employee surface soil ingestion in Area A, shows a total carcinogenic risk of 6.8E-03. This risk exceeds the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. Aldrin, dieldrin, and 4,4'-DDT show individual risks which range from 2.0E-

04 to 6.2E-03 and combined are responsible for the entire risk.

The hazard index for potential future site worker/employee surface soil ingestion in Area A is 2.9E+01. This hazard index exceeds the USEPA's target level of one. Aldrin, dieldrin, and 4,4'-DDT show individual hazard quotients which range from 1.1E+00 to 2.2E+01 and combined are responsible for the entire hazard index. The target organ for all three of these chemicals is the liver.

Table C-13, potential future site worker/employee inhalation of surface soil in Area A, shows a total carcinogenic risk of 1.6E-05. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future site worker/employee inhalation of surface soil in Area A could not be calculated as no chemicals of potential concern currently have established reference doses.

Area B - Site Workers/Employees

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future site workers/employees in Area B are presented in Tables C-14 through C-16 of Appendix C.

Table C-14, potential future site worker/employee surface soil ingestion in Area B, shows a total

carcinogenic risk of 2.6E-05. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future site worker/employee surface soil ingestion in Area B, 3.1E-01, falls below the USEPA's target level of one.

Table C-15, potential future site worker/employee dermal contact with surface soil in Area B, shows a total carcinogenic risk of 1.4E-07. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future site worker/employee dermal contact with surface soil in Area B could not be calculated as 2,3,7,8-TCDD does not currently have an established oral reference dose and no other chemicals of potential concern have established dermal absorption factors.

Table C-16, potential future site worker/employee inhalation of surface soil in Area B, shows a total carcinogenic risk of 1.3E-07. This risk falls outside and below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future site worker/employee inhalation of surface soil in Area B, 1.3E-02, falls well below the USEPA's target level of one.

Area C - Site Workers/Employees

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future site workers/employees in Area C are presented in Tables C-17 through C-19 of Appendix C.

Table C-17, potential future site worker/employee surface soil ingestion in Area C, shows a total carcinogenic risk of 7.0E-06. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future site worker/employee surface soil ingestion in Area C, 6.8E-02, falls well below the USEPA's target level of one.

Table C-18, potential future site worker/employee dermal contact with surface soil in Area C, shows a total carcinogenic risk of 1.8E-07. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future site worker/employee dermal contact with surface soil in Area C could not be calculated as 2,3,7,8-TCDD does not currently have an established oral reference dose and no other chemicals of potential concern have established dermal absorption factors.

Table C-19, potential future site worker/employee inhalation of surface soil in Area C, shows a total carcinogenic risk of 1.3E-07. This risk falls outside and below the USEPA's 10^{-4} to 10^{-6}

target risk range.

The hazard index for potential future site worker/employee inhalation of surface soil in Area C, 2.3E-02, falls well below the USEPA's target level of one.

5.3.2 Subsurface Soil

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future construction worker subsurface soil exposures in Areas A and B are presented in Tables C-20 through C-23 of Appendix C. A qualitative discussion on the risk determination for Area C construction workers and a qualitative discussion on the test pit soil results are also included in this subsection.

Area A - Construction Workers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future construction workers in Area A are presented in Tables C-20 through C-21 of Appendix C.

Table C-20, potential future construction worker subsurface soil ingestion in Area A, shows a total carcinogenic risk of 4.0E-06. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future construction worker subsurface soil ingestion in Area A is

1.3E+00. This hazard index exceeds USEPA's target level of one. 4,4'-DDT shows an individual hazard quotient of 1.1E+00 and contributes nearly 85 percent to the hazard index. No other chemicals show hazard quotients above one.

Table C-21, potential future construction worker subsurface soil inhalation in Area A, shows a total carcinogenic risk of 1.8E-09. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future construction worker subsurface soil inhalation in Area A, could not be calculated as no chemicals of potential concern currently have established subchronic inhalation reference doses.

Area B - Construction Workers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future construction workers in Area B are presented in C-22 through C-23 of Appendix C.

Table C-22, potential future construction subsurface soil ingestion in Area B, shows a total carcinogenic risk of 8.8E-06. This risk falls within the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future construction worker subsurface soil ingestion in Area B is 3.0E+00. This hazard index exceeds the USEPA's target level of one. 4,4'-DDT shows a hazard

quotient of 3.0E+00 and is responsible for the entire hazard index. No other chemicals show hazard quotients above one.

Table C-23, potential future construction worker subsurface soil inhalation in Area B, shows a total carcinogenic risk of 2.0E-09. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for potential future construction worker subsurface soil inhalation in Area B, could not be calculated as no chemicals of potential concern currently have established subchronic inhalation reference doses.

Area C - Construction Workers

Although CLP analyses were not performed on the subsurface soil in Area C, screening data for Area C was obtained by the Dexsil method for chlorinated compounds and X-ray Fluorescence (XRF) for arsenic, cadmium, chromium, and lead. Twenty borings were drilled with 36 samples collected and 8 duplicates for Dexsil and XRF analyses.

A qualitative comparison of the subsurface screening data for Area C to subsurface screening data and CLP data for Areas A and B was performed. The November 29, 1994 report, prepared by consultants to PPG Industries, compared the performance of two different field screening test kits in relation to the fixed-base laboratory analytical results for DDT and its metabolites. The two

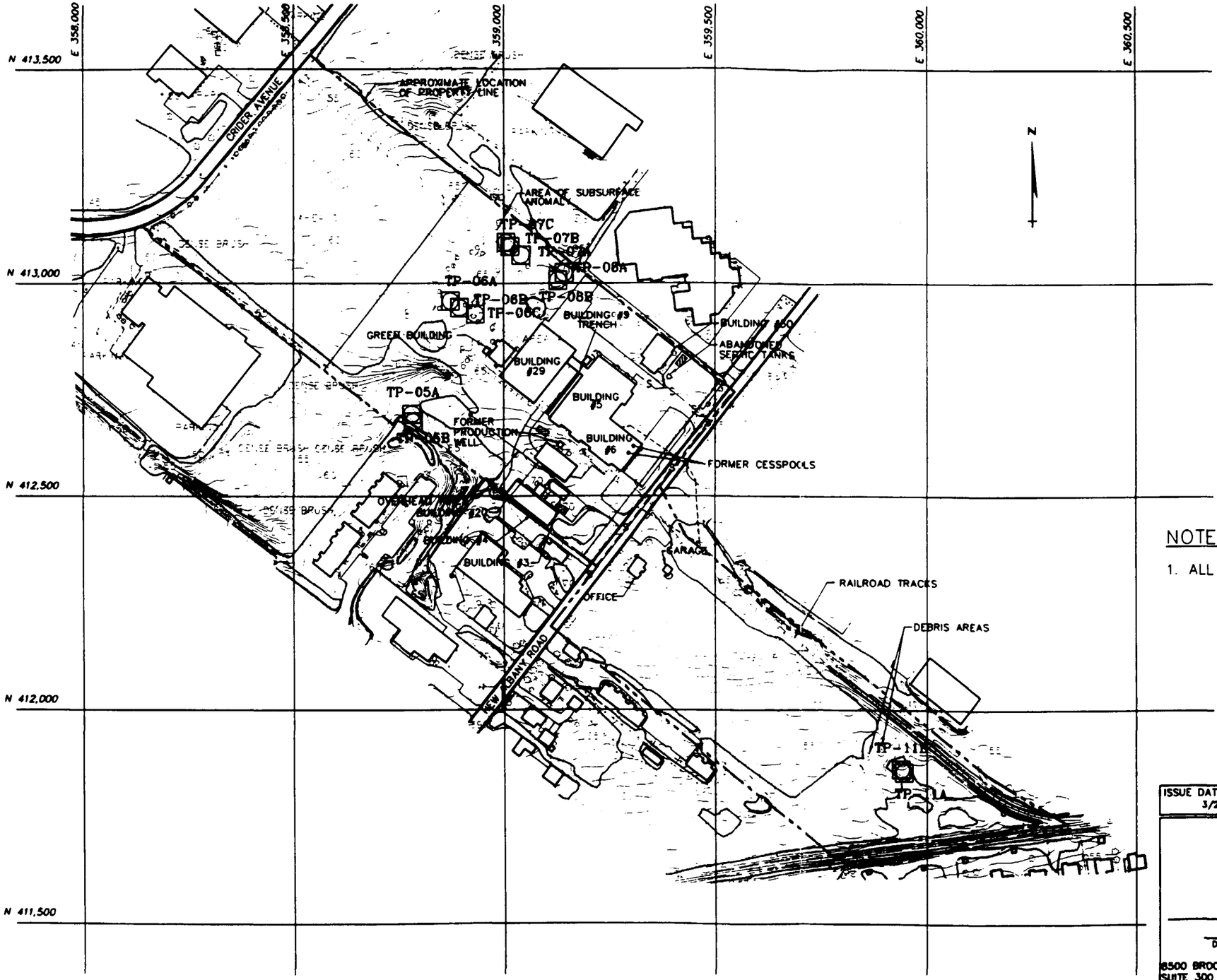
test kits utilized were Millipore (immunoassay test kit for DDT and its metabolites) and Dexsil (colorimetric test kit for chloride ions). The conclusions reached in this analysis were that the Dexsil test kit results, when compared to the total DDT concentrations determined by CLP procedures, were within the variation expected when using the CLP methods. The report concluded that the Dexsil field screening technique appeared to provide a surrogate measurement for the total DDT at the site. The Millipore test kit results did not lie within the expected variation compared to CLP methods. Therefore, the field screening method utilized at the site was the Dexsil method.

No quantitative risk analysis was performed for Area C. However, based on a qualitative evaluation of the Dexsil field screening data for that area, the risks and hazards to construction workers in Area C from DDT and its metabolites are likely to fall within or below EPA's risk range of 10^{-4} to 10^{-6}. The carcinogenic risks for Area A and Area B were within the EPA target risk range (10^{-4} to 10^{-6}) and the noncarcinogenic hazard index for DDT exceeded its target range of one by less than one order of magnitude. Screening-level concentrations of DDT and its metabolites in Area C were one or two orders of magnitude less than laboratory reported concentrations from Area A and two orders of magnitude less than those in Area B. Thus carcinogenic risks for Area C construction workers are likely to be less than for Areas A or B. The metals screening data for Area C were comparable to the laboratory-reported metals concentrations for Areas A and B. Metals did not exceed the noncarcinogenic hazard target level of one for the Area A construction worker pathway; therefore, they are unlikely to exceed the target level for Area C construction workers.

Eight test pits (TP-06A, 06B, 06C, TP-07A, 07B, 07C and TP-08A, 08B) were dug in Area A by the former chemical disposal trenches. Four additional test pits were dug, TP-05A and TP-05B by an area of suspected construction debris fill, and TP-11A and TP-11B by an area of stressed vegetation. Figure 14 indicates the location of these samples. One sample was collected from eight of these test pits for chemical analysis. In addition, two duplicates were collected and analyzed. TP-06B, 06C, 07A, 07B, 07C, 08A, 011A and 011B samples were analyzed for volatile organics, semivolatile organics, pesticides, metals, fungicides, and dioxins.

Table 5-1 presents the results of the test pit analyses. Six volatile organics were detected including acetone, carbon disulfide, 2-butanone, toluene, chlorobenzene, and xylenes; each was detected only once or twice. Two semivolatiles, hexachlorobenzene and di-n-butylphthalate were detected only once. Twelve pesticides were detected in many of the samples with DDT being detected in all the samples. OCDD (a congener of dioxin) was detected in four of the samples. Arsenic, cadmium, chromium, and lead were detected in at least one sample with cadmium and chromium VI detected in only one sample. Fungicides were not detected in any of the test pit samples.

Comparison of the test pit analytical data with New Jersey Soil Cleanup Criteria (2-03-94) indicates that several chemicals exceed the criterion for impact to ground water and would require remediation. These chemicals are DDT and its metabolites. The trench disposal area test pits have been identified by the USEPA as requiring remediation, therefore, they will not be quantitatively evaluated in this report.



LEGEND:

- FENCE
- TREELINE
- SANITARY SEWER DRAIN LINE
- STORM SEWER DRAIN LINE
- UNDERGROUND STORAGE TANK
- GROUND SURFACE ELEVATION CONTOUR
- PROPERTY LINE (APPROXIMATE LOCATION)
- AREA DIVIDE LINE
- TP-05A TEST PIT SAMPLE LOCATION

NOTES:

1. ALL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT-MSL).

SCALE

0 250 500 750 FEET

DRAWING NAME: | CHECK PRINT NUMBER: | EDITING TIME: | TIME: | DATE: | EDITED BY:

ISSUE DATE: 3/27/95

DATE

6500 BROOKTREE ROAD
SUITE 300
WEXFORD, PA. 15090

FIGURE 14

Test Pit Sample Locations

Pulverizing Services Site
Moorestown, New Jersey

Source: Figure No. 3, "Test Pit Sample Locations", Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, McLaren/Hart Environmental Engineering Corporation, March 27, 1995.

700205

TABLE 5-1
TEST PIT DATA
PULVERIZING SERVICES, MOORESTOWN, NJ

Chemical	Frequency of Detection	Concentration Range (mg/kg)	NJ Subsurface Soil Criteria* (2/03/94) (mg/kg)	Exceedance of Criterion
Acetone	2/8	0.011 - 0.025	100	
Carbon Disulfide	1/8	12	NA	
2-Butanone	1/8	0.016	50	
Toluene	2/8	0.015 - 0.63	500	
Chlorobenzene	1/8	0.54	1	
Xylenes	1/8	0.017	10	
Hexachlorobenzene	1/8	2.6	100	
Di-N-Butylphthalate	1/8	1.3	100	
Alpha-BHC	5/8	0.009 - 13	N/A	
Beta-BHC	4/8	0.003 - 0.016	N/A	
Delta-BHC	3/8	0.003 - 0.065	N/A	
Lindane	4/8	0.006 - 0.21	50	
Dieldrin	3/8	0.02 - 43	50	
DDE	1/8	38	50	
DDD	5/8	0.074 - 250	50	Yes
DDT	8/8	0.007 - 950	500	Yes
Endrin Ketone	1/8	0.018	50	
Sevin	6/8	0.5 - 2400	N/A	
Malathion/Sumitox	2/8	0.12 - 0.16	N/A	
Rotenone	1/8	2.3	N/A	
OCDD	4/8	0.0005 - 0.005	N/A	
Arsenic	4/8	1.6 - 147	N/A	
Cadmium	1/8	16	N/A	
Chromium	7/8	1.5 - 82	N/A	
Chromium VI	1/8	2	N/A	
Lead	7/8	3.1 - 45.6	N/A	

* NJAC 7:26D Cleanup Standards for Contaminated Sites, Criteria for Subsurface Soil and Impact to Ground Water.

5.3.3 Ground Water

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future resident (adult and child) and site worker/employee exposures to ground water are presented in Tables C-24 through C-26 of Appendix C.

Site-Wide Residents

Table C-24, potential future residential site-wide ground water ingestion, shows total carcinogenic risks for adults and children of 1.7E-02 and 1.0E-02, respectively. Both risks exceed the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. For adults, alpha-BHC, dieldrin, lindane (total), and arsenic show individual risks which range from 2.0E-04 to 1.3E-02 and combined are responsible for the entire risk. For children, alpha-BHC, dieldrin, lindane (total) and arsenic show individual risks which range from 1.2E-04 to 7.4E-03 and combined are responsible for the entire risk. The 30-year combined total risk for adults and children, 2.8E-02, also exceeds the upper-bound of the USEPA's target risk range.

The hazard index values for potential future adult and child site-wide ground water ingestion are 7.7E+01 and 1.8E+02, respectively. Both hazard index values exceed the USEPA's target level of one. For adults, lindane (total), arsenic, and cadmium show individual hazard quotients which range from 3.0E+00 to 7.0E+01 and combined contribute nearly 99 percent to the hazard index. The target organs for lindane (total) are the liver and kidney; the target organ for cadmium is the

kidney. The individual hazard quotients for these two chemicals exceed one and combined, the hazard index is 6.1E+00. The target organ for arsenic is the skin; its hazard quotient also exceeds one. For children dieldrin, lindane (total), arsenic, and cadmium show individual hazard quotients which range from 1.7E+00 to 1.6E+02 and combined are responsible for the entire hazard index. The target organs for lindane (total) are the liver and kidney; the target organ for dieldrin is the liver; and the target organ for cadmium is the kidney. The individual hazard quotients for each of these chemicals exceed one. The combined hazard index for the liver adding the indices for lindane (total) and dieldrin is 8.8E+00. The combined hazard index for the kidney adding the indices for lindane (total) and cadmium is 1.4E+01. The target organ for arsenic is the skin; its hazard quotient also exceeds one.

Table C-25, potential future adult resident dermal contact with site-wide ground water during showering, shows a total carcinogenic risk of 1.5E-04. This risk exceeds the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. No chemicals individually exceed the target risk range, although alpha-BHC, lindane (total), and arsenic combined contribute greater than 93 percent to the total risk.

The hazard index for potential future adult resident dermal contact with site-wide ground water during showering, 7.4E-01, falls below the USEPA's target level of one.

Site Workers/Employees

Table C-26, potential future site worker/employee site-wide ground water ingestion, shows a total carcinogenic risk of 6.5E-03. This risk exceeds the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. Alpha-BHC, lindane (total), and arsenic show individual risk which range from 1.5E-04 to 4.7E-03 and combined contribute nearly 98 percent to the total risk.

The hazard index for potential future site worker/employee site-wide ground water ingestion is 2.8E+01. Lindane (total), arsenic, and cadmium show individual hazard quotients which range from 1.1E+00 to 2.5E+01 and combined contribute greater than 97 percent to the hazard index. The target organs for lindane (total) are the liver and kidney; the target organ for cadmium is the kidney. The individual hazard quotients for these two chemicals exceed one and combined the hazard index is 2.2E+00. The target organ for arsenic is the skin; its hazard quotient also exceeds one.

5.3.4 Surface Water

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident/trespasser and potential future residential (adult and child) exposure to surface water from Drainage from Area A through Area C and from Area A through Area B are presented in Tables C-27 through C-30 of Appendix C.

Drainage from Area A through Area C - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident/trespasser dermal contact exposure to surface water from Drainage from Area A through Area C, are presented in Table C-27 of Appendix C.

Table C-27, present area resident/trespasser dermal contact with surface water from Drainage from Area A through Area C, shows a total carcinogenic risk of 4.7E-07. This risk falls below the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for present area resident/trespasser dermal contact with surface water from Drainage from Area A through Area C, 2.6E-02, falls well below the USEPA's target level of one.

Drainage from Area A through Area B - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident/trespasser dermal contact exposure to surface water from Drainage from Area A through Area B are presented in Table C-28 of Appendix C.

Table C-28, present area resident/trespasser dermal contact with surface water from Drainage from Area A through Area B, shows a total carcinogenic risk of 4.3E-07. This risk falls below

the USEPA's 10^{-4} to 10^{-6} target risk range.

The hazard index for present area resident/trespasser dermal contact with surface water from Drainage from Area A through Area B, 3.3E-03, falls well below the USEPA's target level of one.

Drainage from Area A through Area C - Residents

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future residential (adult and child) dermal contact exposure to surface water from Drainage from Area A through Area C are presented in Table C-29 of Appendix C.

Table C-29, potential future residential dermal contact with surface water from Drainage from Area A through Area C, shows total carcinogenic risks for adults and children of 8.5E-07 and 4.7E-07, respectively. These risks fall below the USEPA's 10^{-4} to 10^{-6} target risk range. The 30-year combined total risk for adults and children, 1.3E-06, falls within the USEPA's target risk range.

The hazard index values for potential future adult and child dermal contact with surface water from Drainage from Area A through Area C are 1.2E-02 and 2.6E-02, respectively. These hazards fall well below the USEPA's target level of one.

Drainage from Area A through Area B - Residents

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future residential (adult and child) dermal contact exposure to surface water from Drainage from Area A through Area B are presented in Table C-30 of Appendix C.

Table C-30, potential future residential dermal contact with surface water from Drainage from Area A through Area B, shows total carcinogenic risks for adults and children of 7.8E-07 and 4.3E-07, respectively. These risk fall below the USEPA's 10^{-4} to 10^{-6} target risk range. The 30-year combined total risk for adults and children, 1.2E-06, falls within the USEPA's target risk range.

The hazard index values for potential future adult and child dermal contact with surface water from Drainage from Area A through Area B are 1.5E-03 and 3.3E-03, respectively. These hazards fall well below the USEPA's target level of one.

5.3.5 Sediment

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident/trespasser and potential future residential (adult and child) exposure to sediment in Drainage from Area A through Area C and from Area A through Area B are presented in Tables C-31 through C-34 of Appendix C.

Drainage from Area A through Area C - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident/trespasser dermal contact exposure to sediment in Drainage from Area A through Area C are presented in Table C-31 of Appendix C.

For Table C-31, present area resident/trespasser dermal contact with sediment in Drainage from Area A through Area C, a total carcinogenic risk could not be calculated as cadmium does not currently have an established oral slope factor and no other chemicals of potential concern have established dermal absorption factors.

The hazard index for present area resident/trespasser dermal contact with sediment in Drainage from Area A through Area C, 8.2E-05 falls well below the USEPA's target level of one.

Drainage from Area A through Area B - Area Residents/Trespassers

The results of carcinogenic risk and noncarcinogenic hazard index calculations for present area resident/trespasser dermal contact exposure to sediment in Drainage from Area through Area B are presented in Table C-32 of Appendix C.

For Table C-32, present area resident/trespasser dermal contact with sediment in Drainage from Area A through Area B, a total carcinogenic risk could not be calculated as cadmium does not

currently have an established oral slope factor and no other chemicals of potential concern have established dermal absorption factors.

The hazard index for present area resident/trespasser dermal contact with sediment in Drainage from Area A through Area B, 1.1E-03, falls well below the USEPA's target level of one.

Drainage from Area A through Area C - Residents

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future residential (adult and child) dermal contact exposure to sediment in Drainage from Area A through Area C are presented in Table C-33 of Appendix C.

For Table C-33, potential future residential dermal contact with sediment in Drainage from Area A through Area C, total carcinogenic risk for adults and children could not be calculated as cadmium does not currently have an established oral slope factor and no other chemicals of potential concern have established dermal adsorption factors.

Hazard index values for potential future adult and child dermal contact with sediment in Drainage from Area A through Area C, 3.7E-05 and 8.2E-05, respectively, fall well below the USEPA's target level of one.

Drainage from Area A through Area B - Residents

The results of carcinogenic risk and noncarcinogenic hazard index calculations for potential future residential (adult and child) dermal contact exposure to sediment in Drainage from Area A through Area B are presented in Table C-34 of Appendix C.

For Table C-34, potential future residential dermal contact with sediment in Drainage from Area A through Area B, total carcinogenic risks for adults and children could not be calculated as cadmium does not currently have an established oral slope factor and no other chemicals of potential concern have established dermal adsorption factors.

Hazard index values for potential future adult and child dermal contact with sediment in Drainage from Area A through Area B, 4.9E-04 and 1.1E-03, respectively fall well below the USEPA's target level of one.

5.4 Combining Cancer Risks and Noncancer Hazard Index Values Across Exposure Pathways

Multichemical cancer risk/noncancer hazard estimates across exposure pathways may be combined for an exposed receptor group(s) provided that the same group(s) would consistently face the RME by more than one pathway. Cancer risks from various exposure pathways are assumed to be additive, as long as the risks are for the same individuals and time period. For noncarcinogens, the total hazard index for each exposure duration (i.e., chronic, subchronic) was calculated

separately.

The summing of appropriate carcinogenic risks and noncarcinogenic hazard index values is presented in Tables 5-2 and 5-3, respectively. The carcinogenic risks which exceed the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range occur for area resident/trespasser surface soil exposure in Area A, residential surface soil exposure in Areas A and C (Combined) and in Area B, site worker/employee surface soil exposure in Area A, and residential and site worker/employee site-wide ground water exposure.

Numerous hazard index values exceed the USEPA's target level of one including area resident/trespasser surface soil exposure in Area A, residential surface soil exposure Areas A and C (Combined) and in Area B, site worker/employee surface soil exposure in Area A, construction worker subsurface soil exposure in Area A and in Area B, and residential and site worker/employee site wide ground water exposure.

5.5 Toxicity Endpoints/Target Organs for Noncarcinogenic Chemicals of Potential Concern Quantitatively Evaluated in the Risk Assessment

Table 5-4 presents the available toxicity endpoints (i.e., target organs) for the noncarcinogenic chemicals of potential concern which have been quantitatively evaluated in this risk assessment, and show hazard quotients above one. Per the RAGS (USEPA, 1989a) guidance, in the calculation of the hazard index (see Section 5.2 for a detailed discussion of hazard index),

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TABLE 5-2

PULVERIZING SERVICES SITE
COMBINING CARCINOGENIC RISKS ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL CANCER RISK	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO RISK
SURFACE SOIL				
Area A	Area Residents/	Ingestion	1.3E-03	Dieldrin
	Trespassers:	Inhalation of Particulates	3.7E-07	--
	Children	**Total Carcinogenic Risk =**	1.3E-03	Dieldrin
	(12-17 years old)			
Area B	Area Residents/	Ingestion	4.9E-06	--
	Trespassers:	Dermal Contact	2.5E-08	--
	Children	**Total Carcinogenic Risk =**	4.9E-06	--
	(12-17 years old)			
Area C	Area Residents/	Ingestion	1.3E-06	--
	Trespassers:	Dermal Contact	3.2E-08	--
	Children	**Total Carcinogenic Risk =**	1.3E-06	--
	(12-17 years old)			
Areas A and C (Combined)	Residents:			
	Adults	Ingestion	1.8E-02	Aldrin, Dieldrin, 4,4'-DDT
		Inhalation of Particulates	4.8E-05	--
		Total Carcinogenic Risk =	1.8E-02	Dieldrin, 4,4'-DDT
	Children (0-6 years old)	Ingestion	4.2E-02	Aldrin, Dieldrin, 4,4'-DDT
		Inhalation of Particulates	4.0E-05	--
		Total Carcinogenic Risk =	4.2E-02	Aldrin, Dieldrin, 4,4'-DDT
Area B	Residents:			
	Adults	Ingestion	6.9E-05	--
		Dermal Contact	4.5E-07	--
		Inhalation of Particulates	3.9E-07	--
		Total Carcinogenic Risk =	7.0E-05	--
	Children (0-6 years old)	Ingestion	1.6E-04	No chemicals exceed the upper-bound of the target risk range.
		Dermal Contact	1.3E-07	--
		Inhalation of Particulates	3.3E-07	--
		Total Carcinogenic Risk =	1.6E-04	--
Area A	Site Workers/	Ingestion	6.8E-03	Aldrin, Dieldrin, 4,4'DDT
	Employees	Inhalation of Particulates	1.6E-05	--
		Total Carcinogenic Risk =	6.8E-03	Aldrin, Dieldrin, 4,4'DDT

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TABLE 5-2

PULVERIZING SERVICES SITE
COMBINING CARCINOGENIC RISKS ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL CANCER RISK	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO RISK
SURFACE SOIL (CONT'D)				
Area B	Site Workers/ Employees	Ingestion	2.6E-05	--
		Dermal Contact	1.4E-07	--
		Inhalation of Particulates	1.3E-07	--
		Total Carcinogenic Risk =	2.6E-05	--
Area C	Site Workers/ Employees	Ingestion	7.0E-06	--
		Dermal Contact	1.8E-07	--
		Inhalation of Particulates	1.3E-07	--
		Total Carcinogenic Risk =	7.3E-06	--
SUBSURFACE SOIL				
Area A	Construction Workers	Ingestion	4.0E-06	--
		Inhalation of Particulates	1.8E-09	--
		Total Carcinogenic Risk =	4.0E-06	--
Area B	Construction Workers	Ingestion	8.8E-06	--
		Inhalation of Particulates	2.0E-09	--
		Total Carcinogenic Risk =	8.8E-06	--
GROUND WATER				
(Saturated Surficial Aquifer) (Site-Wide)	Residents: Adults	Ingestion	1.7E-02	alpha-BHC, Dieldrin, Lindane (Total), Arsenic
		Dermal Contact (Shower)	1.5E-04	No chemicals exceed the upper-bound of the target risk range.
		Total Carcinogenic Risk =	1.7E-02	alpha-BHC, Dieldrin, Lindane (Total), Arsenic
	Children (0-6 years old)	Ingestion	1.0E-02	alpha-BHC, Dieldrin, Lindane (Total), Arsenic
		Total Carcinogenic Risk =	1.0E-02	alpha-BHC, Dieldrin, Lindane (Total), Arsenic
	Site Workers/ Employees	Ingestion	6.5E-03	alpha-BHC, Lindane (Total), Arsenic
		Total Carcinogenic Risk =	6.5E-03	alpha-BHC, Lindane (Total), Arsenic
SURFACE WATER				
Drainage from Area A through Area C	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	4.7E-07	--
		Total Carcinogenic Risk =	4.7E-07	--

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TABLE 5-2

PULVERIZING SERVICES SITE
COMBINING CARCINOGENIC RISKS ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	INDIVIDUAL CANCER RISK	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO RISK
SURFACE WATER (CONT'D)				
Drainage from Area A through Area B	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	4.3E-07	--
		Total Carcinogenic Risk =	4.3E-07	--
Drainage from Area A through Area C	Residents: Adults	Dermal Contact	8.5E-07	--
		Total Carcinogenic Risk =	8.5E-07	--
	Children (12-17 years old)	Dermal Contact	4.7E-07	--
		Total Carcinogenic Risk =	4.7E-07	--
Drainage from Area A through Area B	Residents: Adults	Dermal Contact	7.8E-07	--
		Total Carcinogenic Risk =	7.8E-07	--
	Children (12-17 years old)	Dermal Contact	4.3E-07	--
		Total Carcinogenic Risk =	4.3E-07	--
SEDIMENT				
Drainage from Area A through Area C	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	NA	--
		Total Carcinogenic Risk =	NA	--
Drainage from Area A through Area B	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	NA	--
		Total Carcinogenic Risk =	NA	--
Drainage from Area A through Area C	Residents: Adults	Dermal Contact	NA	--
		Total Carcinogenic Risk =	NA	--
	Children (12-17 years old)	Dermal Contact	NA	--
		Total Carcinogenic Risk =	NA	--
Drainage from Area A through Area B	Residents: Adults	Dermal Contact	NA	--
		Total Carcinogenic Risk =	NA	--
	Children (12-17 years old)	Dermal Contact	NA	--
		Total Carcinogenic Risk =	NA	--

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TABLE 5-2

PULVERIZING SERVICES SITE
COMBINING CARCINOGENIC RISKS ACROSS PATHWAYS

COMBINING CARCINOGENIC RISKS ACROSS ENVIRONMENTAL MATRICES:

1 - Area Residents/Trespassers: Surface soil exposure durations are the same for Areas A and C and therefore may be combined. Although Area B has the same exposure duration as Areas A and C, it is physically separated from these Areas and has not been combined.

(12-17 years old): Surface Soil (Area A) + Surface Soil (Area C): 1.3E-03 + 1.3E-06 = 1.3E-03

: Surface water exposure duration is the same as sediment exposure duration and therefore may be combined.

(12-17 years old): Surface Water (Drainage from Area A through Area C) + Sediment (Drainage from Area A through Area C): 4.7E-07 + NA = 4.7E-07
(12-17 years old): Surface Water (Drainage from Area A through Area B) + Sediment (Drainage from Area A through Area B): 4.3E-07 + NA = 4.3E-07

2 - Residents: Surface soil exposure durations are the same as ground water exposure durations and therefore may be combined.

Adults: Surface Soil (Areas A and C Combined) + Ground Water: 1.8E-02 + 1.7E-02 = 3.5E-02
Adults: Surface Soil (Area B) + Ground Water: 7.0E-05 + 1.7E-02 = 1.7E-02
Children (0-6 years old): Surface Soil (Areas A and C Combined) + Ground Water: 4.2E-02 + 1.0E-02 = 5.2E-02
Children (0-6 years old): Surface Soil (Area B) + Ground Water: 1.6E-04 + 1.0E-02 = 1.0E-02

: Surface water exposure durations are the same as sediment exposure durations and therefore may be combined.

Adults: Surface Water (Drainage from Area A through Area C) + Sediment (Drainage from Area A through Area C): 8.5E-07 + NA = 8.5E-07
Adults: Surface Water (Drainage from Area A through Area B) + Sediment (Drainage from Area A through Area B): 7.8E-07 + NA = 7.8E-07
Children (12-17 years old): Surface Water (Drainage from Area A through Area C) + Sediment (Drainage from Area A through Area C): 4.7E-07 + NA = 4.7E-07
Children (12-17 years old): Surface Water (Drainage from Area A through Area B) + Sediment (Drainage from Area A through Area B): 4.3E-07 + NA = 4.3E-07

3 - Site Workers/Employees: Surface soil exposure durations are the same as the ground water exposure duration and therefore may be combined.

Site Workers/Employees: Surface Soil (Area A) + Ground Water = 6.8E-03 + 6.5E-03 = 1.3E-02
Site Workers/Employees: Surface Soil (Area B) + Ground Water = 2.6E-05 + 6.5E-03 = 6.5E-03
Site Workers/Employees: Surface Soil (Area C) + Ground Water = 7.3E-06 + 6.5E-03 = 6.5E-03

4 - Construction Workers: Since Area A is physically separated from Area B, development of these Areas by construction workers may not occur at the same time. Therefore, construction worker exposure to subsurface soil in Area A and in Area B has not been combined.

Notes

NA: A carcinogenic risk could not be calculated due to lack of established slope factors.
--: The carcinogenic risk does not exceed the upper-bound of the target risk range or could not be calculated; therefore, no chemicals were selected as contributors.

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TABLE 5-3

PULVERIZING SERVICES SITE
COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	HAZARD INDEX	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO HAZARD INDEX VALUES
SURFACE SOIL				
Area A	Area Residents/	Ingestion	2.3E+01	Dieldrin, 4,4'-DDT
	Trespassers:	Inhalation of Particulates	NA	--
	Children	**Total Hazard Index =**	2.3E+01	Dieldrin, 4,4'-DDT
	(12-17 years old)			
Area B	Area Residents/	Ingestion	2.5E-01	--
	Trespassers:	Dermal Contact	NA	--
	Children	**Total Hazard Index =**	2.5E-01	--
	(12-17 years old)			
Area C	Area Residents/	Ingestion	5.4E-02	--
	Trespassers:	Dermal Contact	NA	--
	Children	**Total Hazard Index =**	5.4E-02	--
	(12-17 years old)			
Areas A and C (Combined)	Residents:			
	Adults	Ingestion	8.2E+01	Aldrin, Dieldrin, 4,4'-DDT
		Inhalation of Particulates	NA	--
		Total Hazard Index =	8.2E+01	Aldrin, Dieldrin, 4,4'-DDT
	Children (0-6 years old)	Ingestion	7.7E+02	Aldrin, Dieldrin, 4,4'-DDT
		Inhalation of Particulates	NA	--
		Total Hazard Index =	7.7E+02	Aldrin, Dieldrin, 4,4'-DDT
Area B	Residents:			
	Adults	Ingestion	8.8E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	4.1E-02	--
		Total Hazard Index =	9.2E-01	--
	Children (0-6 years old)	Ingestion	8.2E+00	4,4'-DDT
		Dermal Contact	NA	--
		Inhalation of Particulates	1.4E-01	--
		Total Hazard Index =	8.3E+00	4,4'-DDT
Area A	Site Workers/	Ingestion	2.9E+01	Aldrin, Dieldrin, 4,4'-DDT
	Employees	Inhalation of Particulates	NA	--
		Total Hazard Index =	2.9E+01	Aldrin, Dieldrin, 4,4'-DDT

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TABLE 5-3

PULVERIZING SERVICES SITE
COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	HAZARD INDEX	CHEMICALS CONTRIBUTING THE GREATE AMOUNT TO HAZARD INDEX VALUES
SURFACE SOIL (CONT'D)				
Area B	Site Workers/ Employees	Ingestion	3.1E-01	--
		Dermal Contact	NA	--
		Inhalation of Particulates	1.3E-02	--
		Total Hazard Index =	3.2E-01	--
Area C	Site Workers/ Employees	Ingestion	6.8E-02	--
		Dermal Contact	NA	--
		Inhalation of Particulates	2.3E-02	--
		Total Hazard Index =	9.1E-02	--
SUBSURFACE SOIL				
Area A	Construction Workers	Ingestion	1.3E+00	4,4'-DDT
		Inhalation of Particulates	NA	--
		Total Hazard Index =	1.3E+00	4,4'-DDT
Area B	Construction Workers	Ingestion	3.0E+00	4,4'-DDT
		Inhalation of Particulates	NA	--
		Total Hazard Index =	3.0E+00	4,4'-DDT
GROUND WATER				
(Saturated Surficial Aquifer) (Site-Wide)	Residents: Adults	Ingestion	7.7E+01	Lindane (Total)
		Dermal Contact (Shower)	7.4E-01	
		Total Hazard Index =	7.8E+01	
	Children (0-6 years old)	Ingestion	1.8E+02	
		Total Hazard Index =	1.8E+02	
	Site Workers/ Employees	Ingestion		
		Total Hazard Index		
SURFACE WATER				
Drainage from Area A through Area C	Area Residents/ Trespa			

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TABLE 5-3

PULVERIZING SERVICES SITE
COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS PATHWAYS

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	HAZARD INDEX	CHEMICALS CONTRIBUTING THE GREATEST AMOUNT TO HAZARD INDEX VALUE
SURFACE WATER (CONT'D)				
Drainage from Area A through Area B	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	3.3E-03	--
		Total Hazard Index =	3.3E-03	--
Drainage from Area A through Area C	Residents: Adults	Dermal Contact	1.2E-02	--
		Total Hazard Index =	1.2E-02	--
	Children (12-17 years old)	Dermal Contact	2.6E-02	--
		Total Hazard Index =	2.6E-02	--
Drainage from Area A through Area B	Residents: Adults	Dermal Contact	1.5E-03	--
		Total Hazard Index =	1.5E-03	--
	Children (12-17 years old)	Dermal Contact	3.3E-03	--
		Total Hazard Index =	3.3E-03	--
SEDIMENT				
Drainage from Area A through Area C	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	8.2E-05	--
		Total Hazard Index =	8.2E-05	--
Drainage from Area A through Area B	Area Residents/ Trespassers: Children (12-17 years old)	Dermal Contact	1.1E-03	--
		Total Hazard Index =	1.1E-03	--
Drainage from Area A through Area C	Residents: Adults	Dermal Contact	3.7E-05	--
		Total Hazard Index =	3.7E-05	--
	Children (12-17 years old)	Dermal Contact	8.2E-05	--
		Total Hazard Index =	8.2E-05	--
Drainage from Area A through Area B	Residents: Adults	Dermal Contact	4.9E-04	--
		Total Hazard Index =	4.9E-04	--
	Children (12-17 years old)	Dermal Contact	1.1E-03	--
		Total Hazard Index =	1.1E-03	--

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TABLE 5-3

PULVERIZING SERVICES SITE
COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS PATHWAYS

COMBINING NONCARCINOGENIC HAZARD INDEX VALUES ACROSS ENVIRONMENTAL MATRICES:

1 - Area Residents/Trespassers: Surface soil exposure durations are the same for Areas A and C and therefore may be combined. Although Area B has the same exposure duration as Areas A and C, it is physically separated from these Areas and has not been combined.

(12-17 years old): Surface Soil (Area A) + Surface Soil (Area C): 2.3E+01 + 5.4E-02 = 2.3E+01

: Surface water exposure duration is the same as sediment exposure duration and therefore may be combined.

(12-17 years old): Surface Water (Drainage from Area A through Area C) + Sediment (Drainage from Area A through Area C): 2.6E-02 + 8.2E-05 = 2.6E-02
(12-17 years old): Surface Water (Drainage from Area A through Area B) + Sediment (Drainage from Area A through Area B): 3.3E-03 + 1.1E-03 = 4.4E-03

2 - Residents: Surface soil exposure durations are the same as ground water exposure durations and therefore may be combined.

Adults: Surface Soil (Areas A and C Combined) + Ground Water: 8.2E+01 + 7.8E+01 = 1.6E+02
Adults: Surface Soil (Area B) + Ground Water: 9.2E-01 + 7.8E+01 = 7.9E+01
Children (0-6 years old): Surface Soil (Areas A and C Combined) + Ground Water: 7.7E+02 + 1.8E+02 = 9.5E+02
Children (0-6 years old): Surface Soil (Area B) + Ground Water: 8.3E+00 + 1.8E+02 = 1.9E+02

: Surface water exposure durations are the same as sediment exposure durations and therefore may be combined.

Adults: Surface Water (Drainage from Area A through Area C) + Sediment (Drainage from Area A through Area C): 1.2E-02 + 3.7E-05 = 1.2E-02
Adults: Surface Water (Drainage from Area A through Area B) + Sediment (Drainage from Area A through Area B): 1.5E-03 + 4.9E-04 = 2.0E-03
Children (12-17 years old): Surface Water (Drainage from Area A through Area C) + Sediment (Drainage from Area A through Area C): 2.6E-02 + 8.2E-05 = 2.6E-02
Children (12-17 years old): Surface Water (Drainage from Area A through Area B) + Sediment (Drainage from Area A through Area B): 4.1E-03 + 1.1E-03 = 5.2E-03

3 - Site Workers/Employees: Surface soil exposure durations are the same as the ground water exposure duration and therefore may be combined.

Site Workers/Employees: Surface Soil (Area A) + Ground Water = 2.9E+01 + 2.8E+01 = 5.7E+01
Site Workers/Employees: Surface Soil (Area B) + Ground Water = 3.2E-01 + 2.8E+01 = 2.8E+01
Site Workers/Employees: Surface Soil (Area C) + Ground Water = 9.1E-02 + 2.8E+01 = 2.8E+01

4 - Construction Workers: Since Area A is physically separated from Area B, development of these Area by construction workers may not occur at the same time. Therefore, construction worker exposure to subsurface soil in Area A and in Area B has not been combined.

Notes

-- : The noncarcinogenic hazard index value does not exceed the target value of one or could not be calculated; therefore, no chemicals were selected as contributors.

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TABLE 5-4

PULVERIZING SERVICES SITE
TOXICITY ENDPOINTS/TARGET ORGANS FOR NONCARCINOGENIC CHEMICALS OF POTENTIAL CONCERN
QUANTITATIVELY EVALUATED IN THE RISK ASSESSMENT

CHEMICALS	TOXICITY ENDPOINT/TARGET ORGAN*
Aldrin	Liver
Dieldrin	Liver
4,4'-DDT	Liver
Lindane (Total)	Liver, Kidney
Arsenic	Skin
Cadmium	Kidney

MATRIX	EXPOSURE ROUTE	RECEPTOR	HAZARD INDEX	HAZARD INDEX BY TOXICITY ENDPOINT/TARGET ORGAN	
Surface Soil:					
Area A		Area Residents/ Trespassers:			
	Ingestion	Children (12-17 years old)	2.3E+01	Dieldrin -	1.7E+01
				4,4'-DDT -	5.3E+00
					2.2E+01 (liver)
Areas A and C (Combined)	Ingestion	Residents: Adults	8.2E+01	Aldrin -	3.2E+00
				Dieldrin -	6.0E+01
				4,4'-DDT -	1.9E+01
					8.2E+01 (liver)
		Children (0-6 years old)	7.7E+02	Aldrin -	2.9E+01
				Dieldrin -	5.6E+02
				4,4'-DDT -	1.7E+02
					7.6E+02 (liver)
Area B	Ingestion	Residents: Children (0-6 years old)	8.2E+00	4,4'-DDT -	7.2E+00
Area A	Ingestion	Site Workers/ Employees: Adults	2.9E+01	Aldrin -	1.1E+00
				Dieldrin -	2.2E+01
				4,4'-DDT -	6.7E+00
					2.9E+01 (liver)

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TABLE 5-4

PULVERIZING SERVICES SITE
TOXICITY ENDPOINTS/TARGET ORGANS FOR NONCARCINOGENIC CHEMICALS OF POTENTIAL CONCERN
QUANTITATIVELY EVALUATED IN THE RISK ASSESSMENT

MATRIX	EXPOSURE ROUTE	RECEPTOR	HAZARD INDEX	HAZARD INDEX BY TOXICITY ENDPOINT/TARGET ORGAN	
Subsurface Soil:					
Area A	Ingestion	Construction Workers: Adults	1.3E+00	4,4'-DDT -	1.1E+00
Area B	Ingestion	Construction Workers: Adults	3.0E+00	4,4'-DDT -	3.0E+00
Ground Water					
Saturated Surficial Aquifer (Site-Wide)	Ingestion	Residents: Adults	7.7E+01	Lindane (Total)	3.1E+00
				Cadmium -	3.0E+00
					6.1E+00 (kidney)
				Arsenic -	7.0E+01 (skin)
		Children (0-6 years old)	1.8E+02	Dieldrin -	1.7E+00 (liver)
				Lindane (Total)	7.1E+00 (liver and kidney)
				Cadmium -	7.0E+00 (kidney)
				(Dieldrin + Lindane (Total))	8.8E+00 (liver)
				(Cadmium + Lindane (Total))	1.4E+01 (kidney)
				Arsenic -	1.6E+02 (skin)
	Ingestion	Site Workers/ Employees:	2.8E+01	Lindane (Total)	1.1E+00
				Cadmium -	1.1E+00
					2.2E+00 (kidney)
				Arsenic -	2.5E+01 (skin)

*Source: Integrated Risk Information System (IRIS) on-line June 26, 1995.

limitations exist which include the following: 1) the level of concern does not increase linearly as the reference dose is approached or exceeded since reference doses do not have equal accuracy or precision and are not based on the same severity of effect; 2) hazard quotients are often combined for substances with reference doses based on critical effects of varying toxicological significance; 3) reference doses of varying levels of confidence that include different uncertainty adjustments and modifying factors (i.e., extrapolation from animals to humans, from LOAELS to NOAELS, and from one exposure duration to another) and, 4) application of the hazard index equation to chemicals not expected to induce the same type of effects or that do not act by the same mechanism may overestimate the potential for adverse health effects.

If the hazard index is greater than one due to the summing of several hazard quotients of similar value, segregation of the hazard index by critical effect and mechanism of action is performed. Upon review of the hazard indices calculated in this risk assessment in Section 5.3 and presented in Appendix C, it was observed that ten hazard index values exceeded one. These exceedances include Area A surface soil ingestion by area residents/trespassers, Area A and C (Combined) surface soil ingestion by adults and children, Area B surface soil ingestion by children, Area A surface soil ingestion by site workers/employees, Area A and Area B subsurface soil ingestion by construction workers, and site-wide ground water ingestion by adults, children, and site workers/employees.

Table 5-4 also presents the breakout of the hazard index values exceeding one by chemical and by target organ(s). Since aldrin, dieldrin, and 4,4'-DDT have the same toxicity endpoint/target

organ, the liver, their hazard quotients have been combined wherever possible. For all of the soil exceedances (surface and subsurface), aldrin, dieldrin, and 4,4'-DDT are the main chemical contributors. For site-wide ground water ingestion by adults, children, and site workers/employees, the hazard index values are due mainly to dieldrin, lindane (total), arsenic, and cadmium which have individual hazard quotients above one. Since lindane (total) has two target organs, the liver and kidney, its hazard quotient has been combined with that of dieldrin and that of cadmium whose respective target organs are the liver and the kidney. The arsenic hazard quotient has not been combined with other hazard quotients as the target organ for arsenic is the skin.

5.6 Applicable or Relevant and Appropriate Requirements (ARARs)

The National Contingency Plan (NCP) and Section 121(d) of CERCLA (cleanup standards) requires that the selected remedial actions at Superfund sites attain or exceed applicable or relevant and appropriate requirements (ARARs) of federal laws and more stringent promulgated state laws.

ARARs are identified to determine media and chemical contaminants that may require remediation and regulations that may apply to remedial action.

A requirement under CERCLA and under other environmental laws may be either "applicable" or "relevant and appropriate" to a remedial action, but not both. A two-tiered approach may be applied: first, to determine whether a given requirement is applicable, then, if it is not applicable,

to determine whether it is relevant and appropriate. These terms are defined in the NCP as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable. Examples of applicable requirements are Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act for contamination of a drinking water supply aquifer.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations described above, that, while not "applicable", address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well-suited to the particular site.

- Other requirements to be considered (TBCs) are non-promulgated federal and state advisories or guidance documents. These do not have status as potential ARARs; however, these advisories or guidance documents may be considered in determining the necessary level of cleanup for the protection of health or the environment.

The USEPA divides ARARs into three categories: chemical-specific, location-specific, and action-specific. This distinction is based on whether the requirement is triggered by the presence or emission of a chemical, by a sensitive or protected location, or by a particular remedial action, respectively.

Chemical-specific ARARs are useful in identifying chemicals that may pose a risk and require remediation, and may be selected as cleanup levels that must be achieved by a particular action.

Chemical-specific requirements set concentration limits or ranges in various environmental media for specific hazardous substances, pollutants or contaminants. These requirements (i.e., MCLs) may represent protective levels for designated media.

USEPA Region II federal and state MCLs have been identified in this risk assessment for the selected chemicals of potential concern in site ground water (see Table 2-24). These MCLs were obtained from the Region II Drinking and Ground Water Standards Update (USEPA, 1993b). Table 5-5 presents the MCLs along with the range of detected concentrations of chemicals of potential concern for comparative purposes.

Preliminary remediation goals have been calculated for those chemicals of potential concern in ground water not having established federal or state MCLs (i.e., alpha-BHC and dieldrin) and are presented in Section 7.0.

For pesticides in Table 5-5, the maximum detected concentration only of lindane (total) exceeds its federal and state MCL. As mentioned above, neither alpha-BHC nor dieldrin have an established federal or state MCL. The maximum detected concentrations of the inorganics arsenic and cadmium exceed their respective federal and state MCLs. Only the minimum detected concentration of cadmium, however, exceeds its MCLs.

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TABLE 5-5

PULVERIZING SERVICES SITE
DETECTED CONCENTRATIONS VERSUS FEDERAL AND STATE MAXIMUM CONTAMINANT LEVELS (MCLS) FOR
CHEMICALS OF POTENTIAL CONCERN IN SITE GROUND WATER (ug/l)

	Range of Detected Concentrations		MCL (1)	
CHEMICALS	Minimum	Maximum	Federal	State (New Jersey)
PESTICIDES:				
alpha-BHC	0.26 JN	69.0 DJ	NA	NA
Dieldrin	0.21	1.35 J	NA	NA
Lindane (Total)	0.07	33.5 D	0.2	0.2
INORGANICS				
Arsenic	6.80 B	771	50	50
Cadmium	7.30	54.6 J	5	5

(1) Region II Drinking and Groundwater Standards Update (USEPA, 1993b).

NA: Not Available

6.0 UNCERTAINTIES IN RISK ASSESSMENT

As in any risk assessment, the estimates of potential health threats (carcinogenic risks and noncarcinogenic health effects) for the Pulverizing Services site sample data have numerous associated uncertainties. In general, the primary areas of uncertainty include the following:

- Environmental data
- Exposure pathway assumptions
- Toxicological data
- Risk characterization

Uncertainty is always involved in the estimation of chemical concentrations. Errors in the analytical data may stem from errors inherent in sampling and/or laboratory procedures. One of the most effective methods of minimizing procedural or systematic error is to subject the data to a strict quality control review. This quality control review procedure helps to eliminate many laboratory errors. However, even with all data vigorously validated, it must be realized that error is inherent in all laboratory procedures.

The lack of site-specific exposure measurements requires that estimates be made on the basis of literature values and/or professional judgement. These types of estimates were required in the evaluation of exposure scenario input parameters. For example, assumptions were made for the exposure time, frequency, and duration of potential chemical exposures as well as for the quantity

of ingested and/or inhaled chemical contaminants. In general, assumptions were made based on reasonable maximum exposures.

Other standard assumptions used throughout this risk assessment are assumed to represent average values (i.e., 70 kg average adult body weight) or upper-bounds of potential exposure (i.e., ingestion rate) and have been used as appropriate.

Other sources of error in the risk assessment can stem from the use of estimated concentrations and can arise during the calculation of 95 percent UCLs. For example, one-half the SQL was used in the 95 percent UCL calculations as a proxy concentration for non-detect chemicals.

Toxicological data uncertainty is one of the largest sources of error in this risk assessment. Numerous uncertainties are associated with USEPA-derived toxicity values used in risk assessment. One source of uncertainty may include using dose-response information from effects observed at high doses in animals to predict adverse health effects from low level exposures to humans in contact with the chemical in the environment. Another source may be the use of dose-response information from short-term exposure studies to predict the effects of long-term exposure and vice versa. Uncertainties may also arise from using dose-response information in animals to predict human health effects and from homogeneous animal and healthy human populations to predict effects likely to be observed in the general population which consists of individuals with varying sensitivities. In addition, the inability to quantitatively evaluate all chemicals detected at the site due to the lack of sufficient toxicological data may result in underestimation of risks

and/or health effects. The potential toxicological effects of these chemicals have been discussed in Section 4.3 and in Appendix B Toxicological Profiles.

Other toxicological data uncertainty in this risk assessment includes the use of the benzo(a)pyrene oral slope factor in conjunction with relative potency values to develop slope factors for numerous other carcinogenic PAHs, the use of TEFs to develop 2,3,7,8-TCDD toxicity equivalence concentrations, the combining of carcinogens with different weights-of-evidence in the calculation of risk; and the combining of noncarcinogens with different toxicity endpoints in the calculation of hazard index values.

Uncertainty is also involved in the calculation of risk and hazard estimates via the dermal contact with soil pathway. Only cadmium and dioxins could be quantitatively evaluated via this route since these are the only chemicals detected in site soil which have USEPA-established soil dermal absorption factors. The potential exists to underestimate risks/impacts via this pathway since all other chemicals detected in the soil could only be qualitatively addressed. An additional source of uncertainty may include the use of oral toxicity values to evaluate dermal exposures (i.e., cadmium, dioxins).

As a result of the uncertainties described above, this risk assessment should not be construed as presenting absolute risks or hazards. Rather, it is a conservative analysis intended to indicate the potential for adverse impacts to occur, based on a reasonable maximum exposure.

6.1 Central Tendency Calculations

Central tendency is a statistical measure that identifies the single most representative value for an entire distribution of values. As a quantitative measure of uncertainty in this risk assessment, central tendency calculations have been performed utilizing 50th percentile or greater input parameters (i.e., exposure duration) in the risk and hazard index calculations as opposed to the more conservative parameters generally used in risk assessment calculations. Ninetieth percentile or greater input parameters are generally used in the risk assessment for calculation of risk and hazard index values in a given pathway so that the combination of all intake variables results in an estimate of the RME for that pathway. The RME is the maximum exposure that is reasonably expected to occur at a site. The 50th percentile values used in the central tendency calculations are considered to be representative of the general receptor population, but may underestimate the true carcinogenic risk and/or noncarcinogenic health effects to sensitive receptors.

Table 6-1 presents the 50th percentile exposure parameters utilized in the calculation of central tendency for those exposure pathways which have results in exceedance of the upper-bound of the 10^{-4} to 10^{-6} risk range. These parameters were obtained from two USEPA guidance documents, RAGS (USEPA, 1989a) and the Exposure Factors Handbook (USEPA, 1989b), or were based on professional judgement. These parameters were developed in conjunction with and have been approved by the USEPA's Risk Assessment Specialist for the site. The 95 percent UCL concentrations have been utilized in these calculations.

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TABLE 6-1

PULVERIZING SERVICES SITE
VARIABLES USED FOR CHRONIC AND SUBCHRONIC DAILY INTAKE CALCULATIONS FOR CENTRAL TENDENCY EVALUATION

		CONCENTRATIONS		CONTACT PARAMETERS				TIME VARIABLES					
Matrices and Receptor Populations	Exposure Route	CW (mg/l)	CS (mg/kg)	SA (cm2/event)	PC (cm/hr)	IR (1) (variable)	FI (unitless)	ET (hrs/day)	EF (days/yr)	ED (yrs)	AT (2) (years)	CF (3) (variable)	BW (kg)
Surface Soil													
Area Residents (Trespassers) Area A (12-17 years old)	Ingestion	-	SI Data	-	-	50 mg/day	1	-	78	6	70(6)	1E-6 kg/mg	55
Residents (Areas A and C - Combined, Area B)													
Adults	Ingestion	-	SI Data	-	-	50 mg/day	1	-	350	9	70(9)	1E-6 kg/mg	70
Children (0-6 years old)	Ingestion	-	SI Data	-	-	100 mg/day	1	-	350	6	70(6)	1E-6 kg/mg	15
Site Workers/Employees Area A Adults	Ingestion	-	SI Data	-	-	25 mg/day	1	-	250	25	70(25)	1E-6 kg/mg	70
Subsurface Soil													
Construction Workers (Area A and Area B) Adults	Ingestion	-	SI Data	-	-	480 mg/day	1	-	65	1	70(1)	1E-6 kg/mg	70
Ground Water (Saturated Surficial Aquifer)													
Residents													
Adults	Ingestion	SI Data	-	-	-	1.4 l/day	-	-	350	9	70(9)	-	70
Children (0-6 years old)	Ingestion	SI Data	-	-	-	0.7 l/day	-	-	350	6	70(6)	-	15
Adults	Dermal Contact	SI Data	-	18,150 cm2	(4)	-	-	0.3	350	9	70(9)	1E-3 l/cm3	70
Site Workers/Employees	Ingestion	SI Data	-	-	-	1 l/day	-	-	250	25	70(25)	-	70

NOTES:
(1) Ingestion or inhalation rate.
(2) The averaging time (AT) is 70 years for carcinogens, 9 years for noncarcinogens for adult residents, 25 years for noncarcinogens for site workers, 6 years for noncarcinogens for children, and 1 year for subsurface soil construction worker exposures (multiplied by 365 days).
(3) Conversion factor (CF) is 1E-6 kg/mg or 1E-3 l/cm3.
(4) This value is the default value for water when no chemical-specific values are available.

Other Abbreviations:

CW = Chemical concentration in water
CS = Chemical concentration in soil or sediment
SA = Skin surface area available for dermal contact
PC= Chemical-specific dermal permeability constant
FI = Fraction ingested from contaminant source
ET = Exposure Time
EF = Exposure Frequency
ED = Exposure Duration
BW = Body Weight

Tables D-1 through D-9 in Appendix D present the results of the central tendency calculations for those exposure pathways which have results in exceedance of the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range for carcinogens or one for noncarcinogens, under the reasonable maximum case scenario. Table 6-2 presents a comparison of the central tendency results (for these exposure pathways) with their respective RME results. It should be noted that the central tendency results for construction worker subsurface soil ingestion in Area A and in Area B and site worker/employee ground water ingestion are the same as the RME results. The central tendency results are based on the central tendency exposure variables (Table 6-1) approved by the USEPA Risk Assessment Specialist for the site. All other central tendency results are lower than the corresponding RME results (for the same pathway).

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TABLE 6-2

PULVERIZING SERVICES SITE
COMPARISON OF CENTRAL TENDENCY EVALUATION AND REASONABLE MAXIMUM EXPOSURE (RME)
CARCINOGENIC RISKS AND HAZARD INDEX VALUES

MEDIA	RECEPTOR POPULATION	EXPOSURE ROUTE	CARCINOGENIC RISK CTC	CARCINOGENIC RISK RME	DECREASE IN RISK *	HAZARD INDEX CTC	HAZARD INDEX RME	DECREASE IN HAZARD INDEX **
SURFACE SOIL								
Area A	Area Residents/ Trespassers: Children (12-17 years old)	Ingestion	6.4E-04	1.3E-03	2.0	1.2E+01	2.3E+01	1.9
Areas A and C (Combined)	Residents: Adults	Ingestion	3.4E-03	1.8E-02	5.3	4.1E+01	8.2E+01	2.0
	Children (0-6 years old)	Ingestion	2.1E-02	4.2E-02	2.0	3.8E+02	7.7E+02	2.0
Area B	Residents: Children (0-6 years old)	Ingestion	8.0E-05	1.6E-04	2.0	4.1E+00	8.2E+00	2.0
Area A	Site Workers/ Employees	Ingestion	3.4E-03	6.8E-03	2.0	1.5E+01	2.9E+01	1.9
SUBSURFACE SOIL								
Area A	Construction Workers	Ingestion	(1)	(1)	(1)	1.3E+00	1.3E+00	(2)
Area B	Construction Workers	Ingestion	(1)	(1)	(1)	3.0E+00	3.0E+00	(2)
GROUND WATER								
(Saturated Surficial Aquifer) (Site-Wide)	Residents: Adults	Ingestion	4.6E-03	1.7E-02	3.7	5.4E+01	7.7E+01	1.4
		Dermal Contact (Shower)	3.5E-05	1.5E-04	4.3	(1)	(1)	(1)
	Children (0-6 years old)	Ingestion	7.1E-03	1.0E-02	1.4	1.3E+02	1.8E+02	1.4
	Site Workers/ Employees	Ingestion	6.5E-03	6.5E-03	(2)	2.8E+01	2.8E+01	(2)

NOTES:

CTC: Central Tendency Calculation result
RME: Reasonable Maximum Exposure result

* - Indicates decrease in central tendency risk as compared to the reasonable maximum exposure risk.
** - Indicates decrease in central tendency hazard index value as compared to the reasonable maximum exposure value hazard index value.

(1) The reasonable maximum exposure risk/hazard index did not exceed the upper-bound of the USEPA's 10-4 to 10-6 target risk range or target level of one; therefore, a central tendency risk/hazard index was not calculated.
(2) Per direction from the USEPA Risk Assessment Specialist, the reasonable maximum exposure parameters and the central tendency exposure parameters are the same; therefore, the risk/hazard index value is the same.

7.0 PRELIMINARY REMEDIATION GOALS

7.1 Definition of Preliminary Remediation Goals

Chemical-specific preliminary remediation goals (PRGs) are concentration goals for individual chemicals for specific medium and land use combinations at CERCLA sites. In this section, chemical-specific PRGs were developed based on the risk assessment (i.e., risk-based calculations). Site-specific parameters were used in place of default parameters to reflect site-specific conditions. Risk-based PRGs are initial guidelines only; they do not establish that cleanup to these goals is warranted. A risk-based concentration will be considered a final remediation level after analysis in the Phase I/II investigation and FS and ROD.

For this risk assessment, risk-based PRGs were not needed for any chemicals in a medium with a cumulative cancer risk of less than 10^{-4}, where a hazard index was less than or equal to 1, where the PRGs were clearly defined by ARARs (i.e., MCLs).

Upon review of the spreadsheet calculations for site soils, several exceedances of the USEPA's target levels were noted. For surface soil, carcinogenic risks are in exceedance of 10^{-4} for area residents/trespassers in Area A, adult and child residents in Areas A and C (Combined), child residents in Area B, and site workers/employees in Area A.

Hazard index values exceeded the target level of 1 for surface soil for area residents/trespassers in

Area A, adult and child residents in Areas A and C (Combined), child residents in Area B, and site workers/employees in Area A; and for subsurface soil for construction workers in Area A, and construction workers in Area B.

Risk-based PRGs have been calculated for the carcinogenic effects of COCs with an individual risk greater than 10^{-4} including aldrin, dieldrin, and 4,4'-DDT (residents and workers); and for the noncarcinogenic effects of COCs with hazard quotients greater than 1.0 including aldrin, dieldrin, and 4,4'-DDT (residents and workers) in site soil. The risk-based equations used have been derived to reflect the potential risk from exposure to a chemical given a specific pathway, medium, and land use combination. By setting the risk at 1.0E-06 for a carcinogen and the hazard index at 1 for a noncarcinogen, the concentration terms (risk-based PRG) could be calculated. The formulas presented in the following section have been obtained from the RAGS Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals (USEPA, 1991b).

7.2 Residential Land Use: Soil Ingestion and Inhalation

Under residential land use, risk from the chemical in soil is generally assumed to be due to the direct ingestion route only. For this site, however, the inhalation of suspended soil particulates route has also been included.

Total risk from soil = Risk from ingestion of soil (child to adult)

+ Risk from inhalation of particulates from soil (child to adult)

Since soil ingestion rates are different for children and adults, the risk due to direct ingestion of soil is calculated using an age-adjusted ingestion factor. The age-adjusted soil ingestion factor ($IF_{soil/adj}$) takes into account the difference in daily soil ingestion rates, body weights, and exposure durations for two exposure groups - children (0 to 6 years) and others (7 to 30 years). The exposure frequency (EF) is assumed to be identical for the two exposure groups. For convenience, this ingestion factor has been calculated separately as a time-weighted soil intake, normalized to body weight, and then substituted in the total intake equations (see Equations (2) and (4)). This ingestion factor leads to a more protective risk-based concentration compared to an adult-only assumption. The ingestion factor is in units of mg-yr/kg-day and therefore is not directly comparable to the daily soil intake rate which is in units of mg/kg-day. Equation (1) presents the formula for calculation of the age-adjusted soil ingestion factor.

Age-Adjusted Soil Ingestion Factor

$$IF_{soil/adj}\ (\text{mg-yr/kg-day}) = \frac{(IR_{soil/age\text{-}0\text{-}6} \times ED_{age\ 0\text{-}6})}{BW_{age\ 0\text{-}6}} + \frac{(IR_{soil/age\text{-}7\text{-}30} \times ED_{age\ 7\text{-}30})}{BW_{age\ 7\text{-}30}} \quad (1)$$

Parameters	Definitions (units)	Site-Specific Values
$IF_{soil/adj}$	age-adjusted soil ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day
$BW_{age\ 0\text{-}6}$	average body weight from ages 0-6 (kg)	15 kg
$BW_{age\ 7\text{-}30}$	average body weight from ages 7-30 (kg)	70 kg
$ED_{age\ 0\text{-}6}$	exposure duration during ages 0-6 (yrs)	6 yrs
$ED_{age\ 7\text{-}30}$	exposure duration during ages 7-30 (yrs)	24 yrs
$IR_{soil/age\ 0\text{-}6}$	ingestion rate of soil for ages 0-6 (mg/day)	200 mg/day
$IR_{soil/age\ 7\text{-}30}$	ingestion rate of soil for all other ages (mg/day)	100 mg/day

7.2.1 Carcinogens

The total risk for carcinogenic effects has been calculated by combining the appropriate oral slope factor (SF_0) and inhalation slope factor (SF_i) with the intake from soil:

$$\text{Total Risk} = SF_0 \times \text{Intake from ingestion of soil} + SF_i \times \text{Intake from inhalation of soil particulates}$$

Adding appropriate parameters and solving for the concentration (C) results in Equation (2). Equation (3) is the reduced version of Equation (2) using site-specific input parameters. Only the PEF is a default value. This reduced equation was used to calculate the risk-based PRG at the 10^{-6} cancer risk level. It combines the toxicity information of a specific chemical with site-specific exposure parameters for residential land use to generate a concentration for that chemical which corresponds to a 10^{-6} risk level. The risk-based PRGs calculated for residential land use of the site are presented in Table 7-1.

Residential Soil - Carcinogenic Effects

$$TR = \frac{SF_o \times C \times 10^{-6}\ kg/mg \times EF \times IF_{soil/adj}}{AT \times 365\ days/yr} + \frac{SF_i \times C \times ED \times EF \times IR_{air} \times (1/PEF)}{BW \times AT \times 365\ days/yr}$$

$$C\ (mg/kg;\ risk\text{-}based) = \frac{TR \times AT \times 365\ days/yr}{[(SF_0 \times 10^{-6}\ kg/mg \times EF \times IF_{soil/adj}) + (SF_i \times ED \times EF \times IR_{air} \times 1/BW \times (1/PEF))]} \quad \textbf{(2)}$$

where:

Parameters	Definitions (units)	Site-Specific Values
C	chemical concentration in soil (mg/kg)	-
TR	target excess individual lifetime cancer risk (unitless)	10^{-6}
SF_o	oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	chemical-specific
SF_i	inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	chemical-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yrs)	70 yrs
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yrs)	30 yrs
$IF_{soil/adj}$	age-adjusted ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day (see Equation 1)
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
PEF	particulate emission factor (m^3/kg)	4.63×10^9 m^3/kg

Reduced Equation: Residential Soil - Carcinogenic Effects

$$\text{Risk-based PRG (mg/kg; TR} = 10^{-6}) = \frac{2.6E\text{-}02}{(SF_o \times 4.0E\text{-}02) + (SF_i \times 6.5E\text{-}07)]} \quad \textbf{(3)}$$

where:

SF_o = oral slope factor in $(mg/kg\text{-}day)^{-1}$

SF_i = inhalation slope factor in $(mg/kg\text{-}day)^{-1}$

7.2.2 Noncarcinogens

The total hazard index has been calculated by combining the appropriate oral and inhalation reference doses with the intakes from soil. These intakes were combined and a risk-based PRG was derived to be protective for both exposure pathways.

$$\text{Hazard Index} = \frac{\text{Intake from ingestion of soil}}{RfD_0} + \frac{\text{Intake from inhalation of soil particulates}}{RfD_i}$$

Adding appropriate parameters and solving for the concentration (C) results in Equation (4). Equation (5) is the reduced version of Equation (4), using site-specific input parameters. This reduced equation was used to calculate the risk-based PRG at the target level of 1. It combines the toxicity information of a specific chemical with site-specific exposure parameters for residential land use to generate a concentration for that chemical that corresponds to a hazard index of 1. The risk-based PRGs calculated for residential land use of the site are presented in Table 7-1.

Residential Soil - Noncarcinogenic Effects

$$THI = \frac{C \times 10^{-6}\ kg/mg \times EF \times IF_{soil/adj}}{RfD_o \times AT \times 365\ days/yr} + \frac{C \times ED \times EF \times IR_{air} \times (1/PEF)}{RfD_i \times BW \times AT \times 365\ days/yr}$$

$$C\ (mg/kg;\ risk\text{-}based) = \frac{THI \times AT \times 365\ days/yrs}{(1/RfD_0 \times 10^{-6}\ kg/mg \times EF \times IF_{soil/adj}) + (1/RfD_i \times ED \times EF \times IR_{air} \times 1/BW \times (1/PEF))} \quad \textbf{(4)}$$

where:

Parameters	Definitions (units)	Site-Specific Values
C	chemical concentration in soil (mg/kg)	-
THI	target hazard index (unitless)	1
RfD_o	chronic oral reference dose (mg/kg-day)	chemical-specific
RfD_i	chronic inhalation reference dose (mg/kg-day)	chemical-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yrs)	30 yrs (for noncarcinogens, equal to ED [which is incorporated in $IF_{soil/adj}$])
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yrs)	30 yrs
$IF_{soil/adj}$	age-adjusted ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day (see Equation 1)
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
PEF	particulate emission factor (m^3/kg)	4.63 x 10^9 m^3/kg

Reduced Equation: Residential Soil - Noncarcinogenic Effects

$$\text{Risk-based PRG (mg/kg; THI = 1)} = \frac{1.1E+04}{[(4.0E-02/RfD_0) + (6.5E-07/RfD_i)]} \quad \textbf{(5)}$$

where:

RfD_0 = chronic oral reference dose in mg/kg-day

RfD_i = chronic inhalation reference dose in mg/kg-day

7.3 Commercial/Industrial Land Use: Soil Ingestion and Inhalation

Under commercial/industrial land use, risk from the chemical in soil was also assumed to be due to direct ingestion and inhalation of particulates from the soil, and was calculated for an adult site worker and construction worker. For this type of land use, it was assumed in calculating the risk-based PRG that the heavy equipment usage in conjunction with construction-related traffic in and around chemically contaminated soils may result in soil being disturbed and particulate emissions being produced.

Intakes from the two exposure pathways were combined and the risk-based PRG was derived to be protective for exposures from both pathways.

Total risk from soil = Risk from ingestion of soil (worker)
+ Risk from inhalation of particulates from soil (worker)

7.3.1 Carcinogens

Total risk fo. carcinogenic effects has been calculated by combining the appropriate oral slope factor (SF_0) and inhalation slope factor (SF_i) with the intakes from soil:

$$\text{Total Risk} = SF_0 \times \text{Intake from ingestion of soil (worker)} + SF_i \times \text{Intake from inhalation of soil particulates (worker)}$$

Adding appropriate parameters and solving for the concentration (C) results in Equation (6).

Equations (7a) and (7b) are the reduced versions of Equation (6) using site-specific input parameters. These reduced equations were used to calculate risk-based PRGs at the 10^{-6} cancer risk level. They combine the toxicity information of a specific chemical with site-specific exposure parameters for commercial/industrial land use to generate concentrations for a specific chemical that correspond to a 10^{-6} risk level. The risk-based PRGs calculated for commercial/industrial land use of the site are presented in Table 7-2.

Commercial/Industrial Soil - Carcinogenic Effects

$$TR = \frac{SF_o \times C \times 10^{-6}\,kg/mg \times ED \times EF \times IR_{soil}}{BW \times AT \times 365\ days/yr} + \frac{SF_i \times C \times ED \times EF \times IR_{air} \times (1/PEF)}{BW \times AT \times 365\ days/yr}$$

$$C\ (mg/kg;\ risk\text{-}based) = \frac{TR \times BW \times AT \times 365\ days/yr}{EF \times ED \times [(SF_0 \times 10^{-6}\ kg/mg \times IR_{soil}) + (SF_i \times IR_{air} \times (1/PEF))]} \quad (6)$$

where:

Parameters	Definitions (units)	Site-Specific Values
C	chemical concentration in soil (mg/kg)	-
TR	target excess individual lifetime cancer risk (unitless)	10^{-6}
SF_o	oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	chemical-specific
SF_i	inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	chemical-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yrs)	70 yrs
EF	exposure frequency (days/yr)	250 days/yr (site worker) 65 days/yr (construction worker)

ED	exposure duration (yrs)	25 yrs (site worker) 1 yr (construction worker)
IR_{soil}	soil ingestion rate (mg/day)	50 mg/day (site worker) 480 mg/day (construction worker)
IR_{air}	inhalation rate (m^3/day)	20 m^3/day
PEF	particulate emission factor (m^3/kg)	4.63 x 10^9 m^3/kg

Reduced Equation: Commercial/Industrial Soil - Carcinogenic Effects

$$\text{Risk-based PRG (mg/kg; TR = } 10^{-6}\text{) (Site worker)} = \frac{2.9E\text{-}04}{[(SF_o \times 5.0E\text{-}05) + (SF_i \times 4.3E\text{-}09)]} \quad \textbf{(7a)}$$

$$\text{Risk-based PRG (mg/kg; TR = } 10^{-6}\text{) (Construction worker)} = \frac{2.8E\text{-}02}{[(SF_o \times 5.0E\text{-}04) + (SF_i \times 4.3E\text{-}09)]} \quad \textbf{(7b)}$$

where:

SF_o = oral slope factor in $(mg/kg\text{-}day)^{-1}$

SF_i = inhalation slope factor in $(mg/kg\text{-}day)^{-1}$

7.3.2 Noncarcinogens

The total hazard index has been calculated by combining the appropriate oral and inhalation reference doses with the two intakes from soil.

$$\text{Hazard Index} = \frac{\text{Intake from ingestion of soil}}{RfD_o} + \frac{\text{Intake from inhalation of particulates}}{RfD_i}$$

Adding appropriate parameters and solving for the concentration (C) results in Equation (8). Equations (9a) and (9b) are the reduced versions of Equation (8), using site-specific input parameters. Only the PEF is a default value. These reduced equations were used to calculate the risk-based PRGs at the target level of 1. They combine the toxicity information of a specific chemical with site-specific exposure parameters for commercial/industrial land use to generate a concentration for a specific chemical that corresponds to a hazard index of 1. The risk-based PRGs calculated for commercial/industrial soil land use are presented in Table 7-2.

Commercial/Industrial Soil - Noncarcinogenic Effects

$$THI = \frac{C \times 10^{-6}\ kg/mg \times EF \times ED \times IR_{soil}}{RfD_0 \times BW \times AT \times 365\ days/yr} + \frac{C \times EF \times ED \times IR_{air} \times (1/PEF)}{RfD_i \times BW \times AT \times 365\ days/yr}$$

$$C\ (mg/kg;\ risk\ based) = \frac{THI \times BW \times AT \times 365\ days/yr}{[ED \times EF \times [((1/RfD_0) \times 10^{-6}\ kg/mg \times IR_{soil}) + ((1/RfD_i) \times IR_{air} \times (1/PEF))]]} \quad \textbf{(8)}$$

where:

Parameters	Definitions (units)	Site-Specific Values
C	chemical concentration in soil (mg/kg)	-
THI	target hazard index (unitless)	1
RfD_0	chronic oral reference dose (mg/kg-day)	chemical-specific
RfD_i	chronic inhalation reference dose (mg/kg-day)	chemical-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yrs)	25 yrs (site worker) 1 yr (construction worker)

EF	exposure frequency (days/yr)	250 days/yr (site worker) 65 days/yr (construction worker)
ED	exposure duration (yrs)	25 yrs (site worker) 1 yr (construction worker)
IR_{soil}	soil ingestion rate (mg/day)	50 mg/day (site worker) 480 mg/day (construction worker)
IR_{air}	workday inhalation rate (m^3/day)	20 m^3/day
PEF	particulate emission factor (m^3/kg)	4.63 x 10^9 m^3/kg

Reduced Equation: Commercial/Industrial Soil - Noncarcinogenic Effects

$$\text{Risk-based PRG (mg/kg: TH=1) (Site worker)} = \frac{102}{[(5E\text{-}05/RfD_o) + (4.3E\text{-}09/RfD_i)]} \quad \textbf{(9a)}$$

$$\text{Risk-based PRG (mg/kg: TH=1) (Construction worker)} = \frac{393}{[(5.0E\text{-}04/RfD_o) + (4.3E\text{-}09/RfD_i)]} \quad \textbf{(9b)}$$

where:

RfD_o = chronic oral reference dose in mg/kg-day

RfD_i = chronic inhalation reference dose in mg/kg-day

TABLE 7-1

PULVERIZING SERVICES SITE
SOIL RISK-BASED PRELIMINARY REMEDIATION GOALS (PRGs)
FOR CARCINOGENS AND NONCARCINOGENS
RESIDENTIAL

Risk-based PRGs (mg/kg)

CHEMICALS	Carcinogens		
	10^{-6}	10^{-5}	10^{-4}
Aldrin	0.038	0.38	3.8
Dieldrin	0.041	0.41	4.1
4,4'-DDT	1.9	19	190

	Noncarcinogens
Aldrin	8.2
Dieldrin	13.8
4,4'-DDT	138

TABLE 7-2

PULVERIZING SERVICES SITE
SOIL RISK-BASED PRELIMINARY REMEDIATION GOALS (PRGs)
FOR CARCINOGENS AND NONCARCINOGENS
COMMERCIAL/INDUSTRIAL

Risk-based PRGs (mg/kg)

CHEMICALS	Carcinogens		
	10^{-6}	10^{-5}	10^{-4}
SITE WORKER			
Aldrin	0.34	3.4	34
Dieldrin	0.36	3.6	36
4,4'-DDT	17	170	1700
CONSTRUCTION WORKER			
Aldrin	3.3	33	330
Dieldrin	3.5	35	350
4,4'-DDT	165	1650	16500

	Noncarcinogens
SITE WORKER	
Aldrin	61
Dieldrin	102
4,4'-DDT	1020
CONSTRUCTION WORKER	
Aldrin	24
Dieldrin	39.3
4,4'-DDT	393

7.4 Residential Land Use: Ground Water Ingestion and Inhalation

In reviewing the spreadsheet calculations for site ground water, all selected chemicals of potential concern, alpha-BHC, dieldrin, lindane (total), arsenic, and cadmium, showed carcinogenic risks and/or noncarcinogenic hazard quotients in exceedance of the USEPA's target levels (10^{-4} to 10^{-6} for carcinogens and 1 for noncarcinogens). Of these chemicals, lindane (total), arsenic, and cadmium have established MCLs (see Table 5-4). PRGs were not calculated for those chemicals having established MCLs. PRGs were therefore calculated for alpha-BHC and dieldrin.

For the calculation of risk-based PRGs, risk-based equations have been derived to reflect the potential risk from exposure to a chemical given a specific pathway, medium, and land use combination. By setting the total risk for carcinogenic effects at a target level of 10^{-6}, (the NCP's point of departure for analysis of remedial alternatives) or the hazard index equal to 1 for noncarcinogens, the concentration terms (risk-based PRGs) can be calculated. The formulae presented below have been obtained from the RAGS HHEM, Part B: Development of Risk-based Preliminary Remediation Goals (USEPA, 1991b).

Under residential land use, risk from chemicals in ground water was assumed to be due primarily to direct ingestion and was calculated for an adult. The inhalation of VOCs while showering pathway was not included as no VOCs were selected as chemicals of potential concern in ground water.

Therefore,

$$\text{Total risk from water} = \text{Risk from ingestion of water (adult)}$$

7.4.1 Carcinogens

The total risk for carcinogenic effects has been calculated by combining the appropriate ingestion slope factor (SF_o) with the ground water ingestion intake.

$$\text{Total risk} = SF_o \times \text{Intake from ingestion of water (adult)}$$

Adding appropriate parameters and solving for the concentration (C) results in Equation (10). Equation (11) is the reduced version of Equation (10) using site-specific input parameters where appropriate. This reduced equation was used to calculate the risk-based PRG at the 10^{-6} cancer risk level. It combines the toxicity information of a specific chemical with site-specific exposure parameters for residential land use to generate a concentration for that chemical that corresponds to a 10^{-6} carcinogenic risk level. The risk-based PRGs calculated for carcinogens for the residential ground water scenario are presented in Table 7-3.

Residential Ground Water - Carcinogenic Effects

$$TR = \frac{SF_o \times C \times IR_w \times EF \times ED}{BW \times AT \times 365 \text{ days/yr}}$$

$$C(mg/l;)_{\text{risk-based}} = \frac{TR \times BW \times AT \times 365 \text{ days/year}}{EF \times ED \times SF_o \times IR_w} \quad \textbf{(10)}$$

Parameters	Definitions (units)	Site-Specific Values
C	chemical concentration in water (mg/l)	-
TR	target excess individual lifetime cancer risk (unitless)	10^{-6}
SF_o	oral cancer slope factor ((mg/kg-day)$^{-1}$)	chemical-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yrs)	70 yrs
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yrs)	30 yrs
IR_w	daily water ingestion rate (1/day)	2 1/day

Reduced Equation: Residential Ground Water - Carcinogenic Effects

$$\text{Risk-based PRG}_{(mg/l:\ TR = 10^{-6})} = \frac{1.7 \times 10^{-4}}{2(SF_o)} \quad \textbf{(11)}$$

TABLE 7-3

PULVERIZING SERVICES SITE
GROUND WATER RISK-BASED PRELIMINARY REMEDIATION GOALS (PRGs)
FOR CARCINOGENS AND NONCARCINOGENS
RESIDENTIAL

Risk-based PRGs (mg/l)

CHEMICALS	Carcinogens		
	10^{-6}	10^{-5}	10^{-4}
alpha-BHC	$1.3x10^{-5}$	$1.3x10^{-4}$	$1.3x10^{-3}$
Dieldrin	$5.3x10^{-6}$	$5.3x10^{-5}$	$5.3x10^{-4}$

	Noncarcinogens
Dieldrin	$1.8x10^{-3}$

7.4.2 Noncarcinogens

The total hazard index has been calculated by combining the appropriate oral reference doses with the ground water ingestion intake.

$$\text{Hazard Index} = \frac{\text{Intake from ingestion of ground water}}{RfD_o}$$

Adding appropriate parameters and solving for the concentration (C) results in Equation (12). Equation (13) is the reduced version of Equation (12), using site-specific input parameters. This reduced equation was used for calculating the risk-based PRG at the target level of 1. It combines the toxicity information of a specific chemical with site-specific exposure parameters for residential land use to generate a concentration for that chemical that corresponds to a hazard index of 1.

The risk-based PRG calculated for noncarcinogens for the residential ground water scenario is presented in Table 7-3. A PRG could not be calculated for alpha-BHC as this chemical does not currently have an established oral reference dose.

Residential Ground Water - Noncarcinogenic Effects

$$THI = \frac{C \times IR_w \times EF \times ED}{RfD_o \times BW \times AT \times 365 \text{ days/yr}}$$

$$C \text{ (mg/l; risk-based)} = \frac{THI \times BW \times AT \times 365 \text{ days/yr}}{EF \times ED \times 1/RfD_o \times IR_w} \quad \textbf{(12)}$$

Parameters	Definitions (units)	Site-Specific Values
C	chemical concentration in water (mg/l)	-
THI	target hazard index (unitless)	1
RfD_o	chronic oral reference dose (mg/kg-day)	chemical-specific
BW	adult body weight (kg)	70 kg
AT	averaging time (yrs)	30 yrs (for noncarcinogens, equal to ED)
EF	exposure frequency (days/yr)	350 days/yr
ED	exposure duration (yrs)	30 yrs
IR_w	daily water ingestion rate (l/day)	2 l/day

Reduced Equation: Residential Ground Water - Noncarcinogenic Effects

$$\text{Risk-based PRG (mg/l; THI = 1)} = \frac{73}{2/RfD_o} \quad \textbf{(13)}$$

where:

RfD_o = chronic oral reference dose in mg/kg-day

The potential exists for the Pulverizing Services site to be residentially developed in the future. Since the NCP encourages protection of ground water to its maximum beneficial use, once the ground water is determined to be suitable for drinking, risk-based PRGs should be based on residential exposure (USEPA, 1991b). Therefore, risk-based PRGs have been developed for residential ground water use only, to be protective of human health.

8.0 SUMMARY OF THE BASELINE RISK ASSESSMENT

In this baseline human health risk assessment, the site matrices surface soil, subsurface soil, ground water, surface water, and sediment at the Pulverizing Services site were quantitatively evaluated for potential health threats to human receptors via the ingestion, dermal contact, and inhalation routes of exposure. Receptors including present area residents/trespassers and potential future residents (adults and children), site workers/employees, and construction workers were evaluated. The estimates of risk and hazard and the greatest chemical contributors to these estimates have been presented and discussed.

As discussed in the Risk Characterization (Section 5.3.2, Subsurface Soil), a comparison of the test pit analytical data with New Jersey Soil Cleanup Criteria indicates that several chemicals exceed the criterion for impact to ground water and would require remediation. These chemicals are DDT and its metabolites. The trench disposal area test pits have been identified by the USEPA as requiring remediation, therefore, they have not been qualitatively evaluated in this report.

Chemicals of potential concern were selected for each matrix based on criteria outlined in RAGS (USEPA, 1989a) and are presented in Section 2.5. The chemicals of potential concern included SVOCs, pesticides, a fungicide, dioxin, and inorganics. The chemicals benzo(g,h,i)perylene, 2-methylnaphthalene, phenanthrene, delta-BHC, endrin ketone, aluminum, cobalt, copper, iron, and lead could not be quantitatively evaluated in this risk assessment due to their lack of established

toxicity values. The essential nutrients (i.e., calcium, magnesium, potassium, and sodium) were not quantitatively addressed, as their potential toxicity is significantly lower than other inorganics at the site, and most existing toxicological data pertain to dietary intake.

Exposure routes and human receptor groups were identified and quantitative estimates of the magnitude, frequency, and duration of exposure were made. Exposure points were estimated using the 95 percent UCL calculation. Chronic and/or subchronic daily intakes for the ingestion, dermal contact, and inhalation routes were calculated for the reasonable maximum exposure (i.e., using 95 percent UCL concentrations and the 90^{th} and 95^{th} percentile exposure parameters).

In the toxicity assessment, current toxicological human health data (i.e., reference doses, reference concentrations, and slope factors) were obtained from various sources and were utilized in the order as specified by RAGS (USEPA, 1989a). Brief toxicological profiles for chemicals which could not be quantitatively evaluated in the risk assessment have been included in this section (4.3). Toxicological profiles for the chemicals of potential concern have been developed and are presented in Appendix B.

Risk characterization involved integrating the exposure and toxicity assessments into quantitative expressions of risks/health effects. Specifically, chronic and subchronic daily intakes were compared with concentrations known or suspected to present health risks or hazards. The carcinogenic risks and noncarcinogenic hazard index values calculated for the site are based on the reasonable maximum exposure (the highest exposure reasonably expected to occur at a site).

The intent is to estimate a conservative exposure case that is still within the range of possible exposures.

In accordance with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) Section 300.430(e)(2) for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}. Per RAGS Part B: Development of Risk-Based Preliminary Remediation Goals (USEPA, 1991b), for noncarcinogenic effects, the NCP does not specify a range, but it is generally appropriate to assume a hazard index equal to one.

In general, the USEPA recommends target values or ranges (i.e., risk of 10^{-4} to 10^{-6} or hazard index of one) as threshold values for potential human health impacts (USEPA, 1989a). The chemicals of potential concern in site ground water were compared to federal and state MCLs. The pesticides alpha-BHC and dieldrin do not currently have established MCLs. The maximum concentration of lindane (total) exceeds its MCLs although the minimum concentration does not. The maximum concentration of arsenic exceeds its MCLs although the minimum concentration does not. Both the minimum and maximum concentrations of cadmium exceed its MCLs.

Human Health Risks and Hazards Identified

The following discussion presents, by receptor group, carcinogenic risks and noncarcinogenic hazard index values in exceedance of the USEPA's target levels for the matrices evaluated in this

risk assessment. Brief mention of those risks and hazards not exceeding any target levels are also included for completeness.

Area Residents/Trespassers

Surface Soil: Present area residents/trespassers in Area A, B, and C were quantitatively evaluated for surface soil exposure via the ingestion, dermal contact (Areas B and C only), and inhalation of particulates (Area A only) routes. The ingestion route of exposure in Area A showed a carcinogenic risk of 1.3E-03 which is in exceedance of the upper-bound of the 10^{-4} to 10^{-6} target risk range. This risk is due largely to dieldrin. The area resident/trespasser ingestion route of exposure in Area A also showed a hazard index of 2.3E+01 which is in exceedance of the USEPA's target level of one. This hazard index is due largely to dieldrin and 4,4'-DDT.

Surface Water: Present area residents/trespassers were quantitatively evaluated for surface water exposure via the dermal contact route in Drainage from Area A through Area C and in Drainage from Area A through Area B. Neither the carcinogenic risks nor the noncarcinogenic hazard index values exceeded the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range or target level of one.

Sediment: Present area residents/trespassers were quantitatively evaluated for sediment exposure via the dermal contact route in Drainage from Area A through Area C and in Drainage from Area A through Area B. Carcinogenic risks could not be calculated due to the lack of established slope

factors and dermal absorption factors. No hazard index values exceeded the USEPA's target level of one.

Residents

Surface Soil: Potential future residents in Areas A and C (Combined) and in Area B were quantitatively evaluated for surface soil exposure via the ingestion, dermal contact (Area B only), and inhalation of particulates routes. The ingestion route of exposure in Areas A and C (Combined) and in Area B showed carcinogenic risks in exceedance of the upper-bound of the target risk range. The only adult risk which exceeded the upper-bound of the target risk range, 1.8E-02, occurred in Areas A and C (Combined). This risk was due largely to aldrin, dieldrin, and 4,4'-DDT. The child risks which exceeded the upper-bound of the target risk range, 4.2E-02 and 1.6E-04, occurred in Areas A and C (Combined) and in Area B, respectively. The adult and child ingestion of surface soil routes of exposure showed hazard index values in exceedance of one for Areas A and C (Combined) and for Area B. An adult hazard index of 8.2E+01 occurred in Areas A and C (Combined) and was largely due to aldrin, dieldrin, and 4,4'-DDT. The child hazard index values which exceeded one, 7.7E+02 and 8.2E+00, occurred in Areas A and C (Combined) and in Area B, respectively. The exceedance in Areas A and C (Combined) was due largely to aldrin, dieldrin, and 4,4'-DDT while the exceedance in Area B was due largely to 4,4'-DDT.

Ground Water: Potential future site residents were quantitatively evaluated for site-wide ground

water exposure via the ingestion and dermal contact (adults only) routes. For adults, both routes of exposure showed carcinogenic risks in exceedance of the upper-bound of the USEPA's target risk range. The adult ingestion risk, 1.7E-02, was due to alpha-BHC, dieldrin, lindane (total), and arsenic. For the dermal contact risk (1.5E-04), no chemicals showed individual risks in exceedance of the target risk range. The child ingestion risk, 1.0E-02, exceeded the upper-bound of the USEPA's target risk range. This risk was due to alpha-BHC, dieldrin, lindane (total), and arsenic.

The ingestion of ground water by adults and children showed hazard index values in exceedance of one. The adult hazard index of 7.7E+01 was due largely to lindane (total), arsenic, and cadmium, while the child hazard index of 1.8E+02 was due to largely to dieldrin, lindane (total), arsenic, and cadmium.

Surface Water: Potential future site residents were quantitatively evaluated for surface water exposure via the dermal contact route. No carcinogenic risks or noncarcinogenic hazard index values exceeded the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range or target level of one.

Sediment: Potential future site residents were quantitatively evaluated for sediment exposure via the dermal contact route. Carcinogenic risks could not be calculated due to the lack of established slope factors and dermal absorption factors. No hazard index values exceeded the USEPA's target level of one.

Site Workers/Employees

Surface Soil: Potential future site workers/employees in Areas A, B, and C were quantitatively evaluated for surface soil exposure via the ingestion, dermal contact (Areas B and C), inhalation of particulates routes. The ingestion routes of exposure in Area A showed a carcinogenic risk of 6.8E-03 which is in exceedance of the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. This risk is due largely to aldrin, dieldrin, and 4,4'-DDT. The site worker/employee ingestion route of exposure in Area A also showed a hazard index of 2.9E+01 which is in exceedance of the USEPA's target level of one. This hazard index is due largely to aldrin, dieldrin, and 4,4'-DDT.

Ground Water: Potential future site workers/employees were quantitatively evaluated for site ground water exposure via the ingestion route. The carcinogenic risk of 6.5E-03 exceeds the upper-bound of the target risk range and is due largely to alpha-BHC, lindane (total), and arsenic. The hazard index of 2.8E+01 exceeds the target level of one and is largely due to lindane (total), arsenic, and cadmium.

Construction Workers

Subsurface Soil: Potential future construction workers in Area A and in Area B were quantitatively evaluated for subsurface soil exposure via the ingestion, and inhalation of particulates routes. Neither of these routes of exposure resulted in carcinogenic risks in

exceedance of the upper-bound of the USEPA's 10^{-4} to 10^{-6} target risk range. The construction worker ingestion routes of exposure in Area A and in Area B showed hazard index values of 1.3E+00 and 3.0E+00, respectively, which are in exceedance of the USEPA's target level of one. These exceedances are due largely to 4,4'-DDT.

In summary, a review of the overall carcinogenic risks for the various matrices and receptor populations showed that present area resident/trespasser exposure to surface soil in Area A via ingestion, potential future residential exposure to surface soil in Areas A and C (Combined) and in Area B (children only) via ingestion, and to ground water via ingestion and dermal contact (adults only), and potential future site worker/employee exposure to surface soil in Area A via ingestion and to ground water via ingestion were in exceedance of the upper-bound USEPA' s target risk range of 10^{-4} to 10^{-6}. A review of the noncarcinogenic hazard index values for the site matrices and receptors showed that present area resident/trespasser exposure to surface soil in Area A via ingestion, potential future residential exposure to surface soil in Areas A and C (Combined) and in Area B (children only) via ingestion and to ground water via ingestion, potential future site worker/employee exposure to surface soil in Area A via ingestion and to ground water via ingestion, and potential future construction worker exposure to subsurface soil in Area A and in Area B via ingestion, exceeded the USEPA's target level of one.

Site-specific uncertainties relating to the risk assessment were qualitatively and quantitatively addressed in Section 6.0. In accordance with standard risk assessment practice, central tendency calculations were performed as a quantitative measure of uncertainty in the risk assessment and

are presented in Tables D-1 through D-9 in Appendix D. The 50th percentile parameters used in these calculations are presented in Table 6-1 were assumed to be representative of the general population. These central tendency calculations, however, have the potential to underestimate true risks/hazard indices for sensitive receptors.

Finally, risk-based PRGs were calculated for residential and commercial/industrial land use for soil and for residential ground water use for risks in exceedance of the upper-bound of the 10^{-4} to 10^{-6} target risk range and for hazard indices greater than one and are presented in Tables 7-1 through 7-3. PRGs were not calculated for chemicals of potential concern in ground water if MCLs exist. Risk-based PRGs are initial guidelines only and do not establish that cleanup to these goals is required. A risk-based concentration is considered a final remediation level only after analysis in the RI/FS and ROD.

9.0 ECOLOGICAL RISK ASSESSMENT

In order to perform this ecological evaluation, CDM Federal Programs Corporation (CDM Federal) conducted a site visit on May 26, 1995. One ARCS II team member, an ecological risk assessor, was present during this site visit. This site visit was conducted to view and document site conditions and habitats in accordance with the qualitative ecological risk assessment approach described in the Work Plan (Volume I 09/01/94, Volume II 09/02/94) and the Technical Approach (06/01/95). The notes taken during this visit are included in Appendix F.

As part of this evaluation, the site chemistry data were reviewed. The following documents were reviewed for information concerning site conditions, levels and types of contamination and potential exposure pathways.

- Phase I Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey, prepared by Paul C. Rizzo Associates, Inc., Revised August 12, 1993.
- Data Submittal: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, prepared by McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc., March 27, 1995.
- Data Submittal II: Phase II Site Investigation, Pulverizing Services Site, Moorestown, New Jersey, prepared by McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc., May 4, 1995.
- Phase II Site Investigation Report, Pulverizing Services Site, Moorestown, New Jersey, prepared by McLaren/Hart Environmental Engineering Corporation for PPG Industries, Inc., May 1, 1995.
- Hydrogeologic and Ground water Use Fact Sheet, Pulverizing Services Site, Moorestown, New Jersey, prepared by Paul C. Rizzo Associates, Inc., not dated.

Input from the U.S. Environmental Protection Agency, Region II, Biological Technical Assistance Group (BTAG) was obtained via a comment memorandum from Shari Stevens, Coordinator of the Biological Technical Assistance Group, to John Osolin, Remedial Project Manager of the New Jersey Superfund Branch II, dated April 1, 1994 concerning the Phase II Site Investigation Work Plan.

Specific ecological receptor lists have not been previously developed for the Pulverizing Services site. General habitats and wildlife observed onsite during the May site visit were documented (Appendix F). Habitats observed at the site include:

Area A:

Predominantly (approximately five acres) -

- Paved industrial lot overgrown with saplings and herbs.

Secondarily (approximately three acres) -

- Grassy strip with landscape trees/shrubs to the southeastern end (facing New Albany Road) that is occasionally mowed.
- Saplings/small trees (less than 15 feet high) and shrubs with scattered herbs and moss as predominant groundcover, surrounding the area of test pit excavations north/northwest of Building 29.
- Currently non-vegetated areas at the locations of the test pit excavation (labelled

as nonvegetated areas north/northwest of Building 29 on Figure in Appendix F).

Area B:

Predominantly (approximately seven acres) -

- Open field that is occasionally mowed, containing grasses and herbs with a few scattered saplings.

Secondarily (approximately one acre) -

- An approximately 15- to 20-foot wide band of forest along the northeastern border of this area (trees ranging to approximately 40 feet in height)
- An approximately 30-foot wide band of forest along the south/southeastern border of this area (trees ranging to approximately 50 feet in height)

Area C:

Predominantly (approximately eight acres) -

- Open field that is occasionally mowed, containing grasses and herbs with a few scattered saplings.

Secondarily (less than one acre) -

- Sparse hedgerow areas along the northwestern and northeastern borders.

Additionally onsite, there are two shallow (less than six inches deep) surface water drainages onsite. The first originates in Area A and flows northwest through Area C. Where observed, the channel of this drainage ranged from approximately four to eight feet wide. This drainage ditch that travels northwesterly from Area A through Area C and ultimately discharges to the North Branch of the Pennsauken Creek (approximately 3/4 miles west of the site). Pennsauken Creek is part of the Delaware River drainage basin and is classified by the New Jersey Department of the Environmental Protection as "FW2 Non Trout". The second drainage ditch originates in Area A at the Building 5 trench, is channelized by culverts and storm drains and runs along the southeastern edge of Area B. At the location observed, the width of this drainage ditch was approximately three feet wide. This drainage appears to be connected with a low, wet area where water pools to the southeastern border of Area B. Trees and shrubs grow densely along the portions of the drainage channels that are not culverted. During the site visit, the drainage ditch in Area C was observed to contain much filamentous algae. Where water existed in these drainages, the flow of water appeared to be slow and the bottom sediment silty.

Offsite habitat immediately adjacent to the site consists of the managed and landscaped yards of residential and commercial properties and narrow bands of forested buffer. Adjacent commercial and light industrial properties also possess a significant amount of paved parking areas.

During the site visit, the following wildlife observations were made:

Area A -

- Eastern cottontail (Sylvilagus floridanus)
- Red-winged blackbird (Agelaius phoeniceus) and nesting starlings (Sturnus vulgaris)

Area B -

- Eastern cottontail (Sylvilagus floridanus)
- Several different bird species, including sparrows, red-winged blackbirds (Agelaius phoeniceus), a warbler, rufous-sided towhee (Pipilo erythrophthalmus), a woodpecker (Picidae family) mockingbird (Mimus polyglottos)
- Tent caterpillar (Malacosoma americanum) and swallowtail butterfly caterpillar (Papilionidae family)

Area C -

- Small mammal running through vegetation (and in other locations, observed small mammal runnels)
- A variety of birds in the hedgerow areas

These wildlife species represent potential ecological receptors of the chemical site contaminants. Other potential receptor species, not observed during this site visit, but may be expected to utilize the site include skunks (for example, Mephitis mephitis), raccoons (Procyon lotor), opossum (Diedelphis marsupilalis), deer (Odocoileus virginianus), birds of prey (for example, Buteo sp.),

and aquatic invertebrates.

Ecological receptors of special interest that may occur in the area may also be found to utilize the site. Special interest receptors include migratory, threatened, endangered, and/or game species. Both Federal and state wildlife agencies were contacted to determine the presence of potential special interest species or habitats at or in the vicinity of the site (Appendix G). The U.S. Fish and Wildlife Service reported that no Federally-listed (or proposed) threatened or endangered species are known to occur in the vicinity of the site, with the exception of an occasional transient bald eagle (Haliaeetus leucocephalus) or peregrine falcon (Falco peregrinus). The State of New Jersey Department of Environmental Protection's Natural Heritage Program did not report any records for rare plants, animals, or natural communities at the site. It appears, however, that there are documented occurrences of rare and/or endangered species within two miles of the site (Appendix G). If appropriate habitat(s) exist onsite (this determination has not been made), the potential exists for reported rare and/or endangered species to exist onsite, thus acting as potential ecological receptors of onsite contamination.

Results of the Phase I and Phase II Site Investigation activities indicate that the primary chemical contaminants of potential concern at the Pulverizing Services site include pesticides and selected metals (arsenic, cadmium, chromium, and lead). Secondary contaminants include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and dioxins. Contaminants have been identified in the surface (zero to six inches below ground surface) and subsurface (deeper than six inches below ground surface) soils, ground water (i.e., surficial aquifer), surface water,

sediment, and air. The distribution of the contaminants are not uniform throughout the site - the highest concentrations appear to be located within Area A.

The following chemicals were detected in the following onsite media:

	Surface Soil[1]	Subsurface Soil[2]	Ground water	Surface Water	Sediment	Air
VOCs			x	x	x	
SVOCs	x	x	x	x	x	
Pesticides	x	x	x	x	x	x
Select Metals[3]	x	x	x	x	x	
Total Organic Halogens	x					
Dioxin	x					

1 - zero to six inches below ground surface

2 - below six inches, but not including the test pit sample results, as the soil of the test pit area is scheduled to be removed from the site in the near future

3 - arsenic, cadmium, chromium, and lead

Offsite soil was sampled at nine locations. These offsite samples were reported to contain organic and inorganic contaminants similar to onsite soils.

The contaminants found onsite (as well as those detected offsite) are known to be toxic or have some adverse health effect on ecological receptors. Of particular concern are those chemicals that are persistent in the environment, are highly toxic to ecological receptors, and/or can be bioaccumulated through the food web. Many of the pesticide compounds detected are of concern because they do possess these characteristics. It should also be noted that, as indicated by BTAG, contaminant availability must be considered as 100 percent for the sediments as no information was collected for pH, total organic carbon content, and grain size.

Contaminant hazards at the Pulverizing Services site can pose an ecological threat only if there is a means by which potential ecological receptors may be exposed to the contaminants (i.e., existence of an exposure pathway or pathways). At the Pulverizing Services site, potential exposure pathways exist for terrestrial ecological receptors via the ingestion, inhalation, and dermal contact with contaminants. Exposure to contaminants in the soil, surface water, and sediment may occur for terrestrial receptors. These receptors are most likely to contact soil at a depth of zero to six inches than at greater depths, however, exposure to deeper soils may also occur for burrowing animals. (No contact with the ground water of the surficial aquifer is expected at this site, since the ground water is reported to be approximately six feet below ground surface and is not reported to discharge onsite.) Aquatic ecological receptors (aquatic invertebrates) also appear to have a complete exposure pathway to site contamination via the

ingestion and contact with site surface water and sediment.

In conclusion, this evaluation of the conditions at the Pulverizing Services site has determined that potential exposure pathways to ecological receptors exist to potentially harmful site contaminants in a variety of media. Therefore, it is recommended that a quantitative ecological assessment of the Pulverizing Services site be conducted to determine the extent of risks posed to the environment due to site contamination.

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